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A JOURNEY THROUGH THE TUNISIAN SAHARA.*

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Towards the close of last November I found myself landed at Humt Suk, the capital of the island of Jerba, with the intention of journeying thence to the French military posts in the Tunisian Sahara, and afterwards visiting the Jerid, or date-producing country, round the dried-up salt lakes in Southern Tunis.

The island of Jerba is more full of history than any other part of the regency of Tunis, with the exception of Carthage and its vicinity. It is supposed to have been the island of Lotos Eaters of the Greeks; the Romans here had most important settlements, the existence of which is attested by the remains of vast public works. It was reconquered from the Arabs by a king of Sicily in the fourteenth century; again taken by a Genoese, who entitled himself "King of Gerba;" and for a brief time was held by the Spaniards in their struggles with the Corsairs in the sixteenth century. At Humt Suk the Spaniards built a most imposing fort, which stands in very good preservation at the present day. Here, however, they sustained a terrible defeat at the hands of the celebrated pirate Dragut, and it is said that twenty-five thousand Spaniards lost their lives on this occasion. Two large columns were built of their skulls, which remained in evidence until 1848, when the Bey of Tunis acceded to a petition of the first Maltese colony in Jerba, and consented to the Spanish skulls being reverently buried by the Maltese at the Christian cemetery at Jerba.

Since the beginning of this century the Maltese colony in Jerba has been an important element. There are, indeed, at the present time only some ten or eleven Europeans in the whole island (which has a superficies

* Map, p. 692.

of about 800 square miles) who are not of Maltese origin. The local population appears to belong mainly to the old Berber stock common to all North Africa, with a very slight introduction of Arab blood, and some European admixture, arising from the constant European descents on Jerba.

The modern Jerbians are a handsome race, very well disposed towards Europeans and French rule. There is an almost entire absence of Mohammedan fanaticism amongst them as regards their attitude towards Christians, though towards each other they show some religious animosity, as they are divided into at least five Mohammedan sects. In addition to their varied forms of Mohammedanism, they retain vestiges of older faiths. In all but the most recently built mosques a phallic emblem is placed on the summit of the minarets. (I shall treat of this subject later on in dealing with the Tunisian Sahara.) Again, in the country districts outside the towns, in almost every household—all the Jerbians are well-to-do farmer folk who live in substantial farmhouses—there is a rude shrine, made and tended by the women of the family, in the vicinity of the house or in the courtyard. This is held to be the abiding-place of a protecting house-spirit, and offerings in the form of libations of oil and wine, or rags of cloth, are placed on the rudely piled stones, which—sometimes smeared with mortar—form a rough cupola or dome over a hollow place. Sometimes the spirit thus worshipped is said to be that of a saint or of an ancestor. The men laugh at these practices, and dislike to be questioned about them. They will refer to the spirit thus worshipped by the women as a "sheitan."

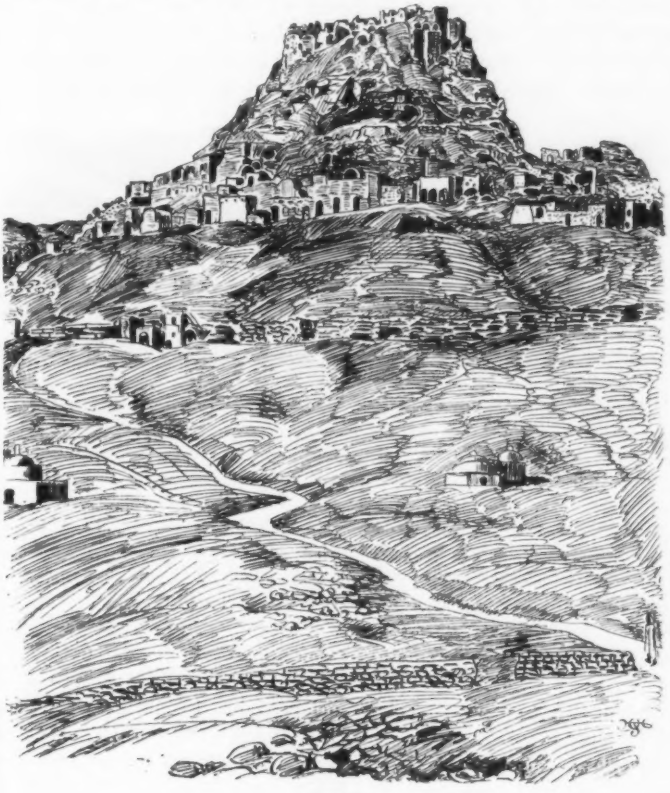
Europeans are allowed—are even invited—to enter the mosques of Jerba. The inhabitants of this most fertile island detested the government of the beys of Tunis, and therefore the French were welcomed here as nowhere else in Tunisia. It must be said truthfully that they have justified the expectations of the inhabitants. Not only have they made life and property absolutely safe throughout the island, but they have relieved the people of many onerous taxes, have made roads and wharves, and have bored several artesian wells. I believe I am correct in saying that there is not a single French soldier in the island—merely a few gendarmes.

Jerba is very flat, but nowhere marshy. The highest land is only some hundred feet above the level of the sea. There is absolutely no watercourse or running water (except an artificial stream, recently made by the tremendous volume of water issuing from an artesian well). Yet everywhere water is near to the surface, sometimes within 6 feet. Wells, therefore, are abundant, and the natives of the island construct underground cisterns, where the rainfall is stored. In consequence of this abundant underground moisture, the island is an ideal home for the date palm,* and the whole island seems to be one huge forest of scattered

* The oft-repeated Arab saying is quite true, that the date palm must have its head in fire and its feet in water.

palm trees. Abundant crops of barley and many vegetables are grown in and out of the date palms, and olive trees and fig trees are nearly as abundant, though not so prominently seen from a distance as the palm trees.

The Controleur Civil of Jerba, M. Ballut, drove me across the island from Humt Suk to El Ajim in his English cart, along a capital French-



DWIRAT.

made road. El Ajim is a port on the shallow strait which separates Jerba from the mainland.* We arrived at El Ajim at low tide, a rare sight in the Mediterranean; but in the Gulf of Gabes the tide rises and falls about 7 feet. Entering a huge boat, like a gigantic flat-bottomed

* This strait at El Ajim is only a few miles in width; elsewhere it may broaden to more than 20 miles. In the direction of Gellala the water is so shallow that, at low tide with a south wind, men can wade across to the mainland.

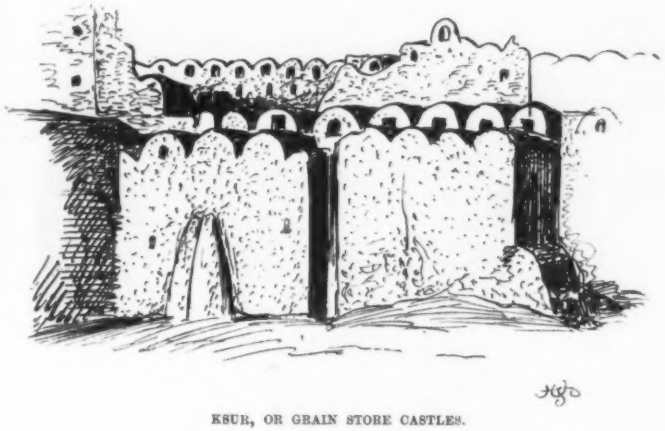
canoe, with a broad sail, we sailed southwards to a point called Bu Ghara. At this place I parted from my kind guide, and rode 15½ miles to the military post of Mednin.

The extreme south of Tunisia still remains under military government, and the *commandant-supérieur* of Mednin is practically the governor of the Tunisian Sahara. At Mednin we come to a remarkable type of desert town. It is mainly composed of "ksūr," or "castles." These are continuous buildings made of rubble and plastered with mud, of several stories in height, and with vaulted roofs. It was explained to me at least five times how the vault was constructed without supports, but

THE SAHARA, FROM DWIRAT.

as I understand not very much Tunisian Arabic, I could not come away with a clear idea. As far as I can understand, the vaulting is effected by overlaying flat stones, and plastering the whole outside and within with a singularly tenacious mud. When every three or four years there is an unusual downpour of rain, these mud and rubble castles are apt to crumble. On the outside of these extraordinary buildings (which form continuous streets) are rude staircases of stone jutting out from the front of the houses. In front of each doorway, on each story, there is a rude slab of stone as the threshold, and, in addition to the fragmentary staircase, many odd blocks of stone or wood project from the surface. By means of these hazardous stairs, the natives will climb to the highest story most nimbly, like goats. Arrived in front of their doorways, they insert a huge wooden key with iron points through a

hole in the wall, and turn a rude lock, which releases a bolt, and thus opens the door.* Formerly the "ksūr" were used as store-houses for grain and for goods, and also for occasional habitation, by the semi-Berber populations, who were always threatened by Tawarek invasions. Though they might not always reside in these towns, but rather in tents, they would resort to them on market days, or when pursued by the enemy. For some time past, however, they have taken to living a settled existence, and round and about a *ksar*† other houses have sprung up of the hovel type, with occasionally a Moorish-looking dwelling for the sheikh, or headman.



KSUR, OR GRAIN STORE CASTLES.

Mednin is rather a large town for the Tunisian Sahara, and presents an imposing appearance seen from the French military camp on an opposite ridge of high ground. In the foreground there is a flat depression with a thin covering of green grass, out of which grows a clump of unusually tall palm trees. Behind this the town rises over a few stone-strewn fields, sparsely cultivated. A winding road—never in daylight without human figures and laden beasts passing to and from the town—strikes at the centre of the serried row of vaulted buildings, and where it pierces the mass of houses there is a pretty white mosque with a green-tiled cupola and a square white minaret.‡

* For illustrations of these extraordinary castles and of the foot-long keys that open their doors, I must refer those specially interested in the matter to some illustrated articles which I am about to publish in the *Graphic*.

† In the singular this word is *ksar*.

‡ In the larger towns of the Tunisian Sahara, and in the Jerid country, the minarets of the mosques are square, and of several stories, somewhat like the Giralda of Seville. In the Sahara these minarets continue to be surmounted by a phallus.

This patch of white stands out with the greater contrast because of the uniform red-mud colour of the rest of the town. The huge vaulted granaries, of perhaps 30 feet in height (though some may be only 10 feet above the level of the ground), resemble at a distance a series of English warehouses. The roof of each building may be divided into five or six parallel vaults. This shape of roof is so difficult to explain in words, that I append a small sketch to better illustrate my meaning.

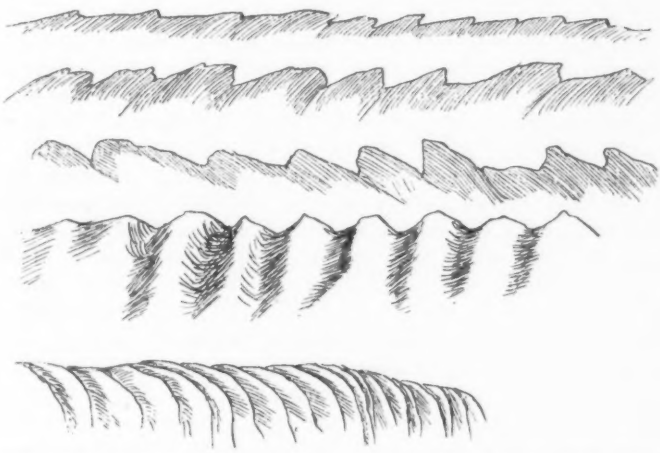
From Mednin I rode 32 miles south-west to Tatawin, or "Fum Tatawin," as it is sometimes called. We rode through regular Sahara country—sandy ground, over which grows in tufts a sparse vegetation,

PHALLIC TEMPLE NEAR DWIRAT, ABOUT 13 FEET HIGH.

with occasional "weds," strewn with boulders, and supporting a growth of thorny bushes. A strong west wind blew up the sand into clouds, and surrounded us at times in a sandy mist. As we approached Tatawin low mountains rose before us, and the scenery became more agreeable to the eye, though rocky and destitute of vegetation. Fūm Tatawin is a collection of white buildings, forming within a large square, and without a rampart against an enemy. In times gone by it was the great resort of the Tawarek, or "Touaregs," from the Sahara, who, if they could manage to ravish and plunder, would come to trade with the Arabized Berber inhabitants. Since the murder of the Marquis de Morès they have ceased coming.

A little distance beyond the native town (which is little more than

a fortified market-place) is the French military camp. Below the market-place and the camp (which are backed by a range of hills) is the Wed Tatawin—a broad, boulder-strewn watercourse. In this watercourse lies the oasis of Tatawin, just beyond the French camp, and where two ranges of hills converge and form a broad gorge. Found in the middle of such a waterless desert, this oasis of palm trees and other vegetation is very striking. Water is never wholly absent from the Wed Tatawin, which is fed by springs. At the time I was there, water was actually running through the oasis, which ultimately lost itself in the sands lower down. I found large pools, thick with a bright green water-weed, and swarming with frogs. I believe fish are found



OUTLINES OF MOUNTAIN RIDGES NORTH AND SOUTH OF THE SHATS OF SOUTH TUNIS.

in these pools also, as they are in the waters of the Jerid oasis (where I have seen them).

Tatawin was not only a Roman station (the Roman camp was situated not far from where the French have established themselves), but appears to have been frequented by some other civilized race in pre-Roman days; such at least is the deduction one forms after examining some very interesting remains recently discovered by the French in the bed of the river. These consist of oblong blocks of stone carved with various designs in low relief, and it is thought that they may be of Punic origin. Pending further arrangements, and to save them from the risk of injury, these stones have been built into the wall of a small unoccupied house in the centre of the military camp. I have copied a selection of the designs on these stones with the most scrupulous accuracy, and leave my readers to form their own deductions as to their

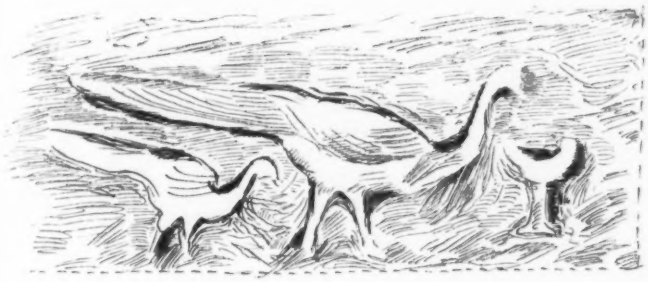
origin. I have been very careful in my reproduction to exaggerate or explain away nothing. In addition to the subjects here illustrated were some less clearly defined. Amongst these I fancied I could make out a representation of a man and an elephant, several lions, and a lion jumping on to some animal. There were also at least four representations of a bird, which I could only liken to a peacock.* About 2 miles from the French camp are the ruins of a Roman tomb, and indiscriminate fragments of Roman masonry.

To the south-west of Tatawin, the mountains of the Sahara assume their typical form of a broken-down plateau. Sometimes it would seem as though this eroded plateau consisted of two different deposits, one on the top of the other. In each mountain one sees first of all a flat wall of stratified rock (surmounted, perhaps, by a loose soil); then follows a smooth slope or talus of rubble, which is interrupted halfway down the mountain-side by a second vertical wall of natural masonry—slabs of rock lying horizontally one on the top of the other, as though placed there by a race of giants. The rock which composes this natural wall is often of a fiery red, almost crimson, colour. At other times it is rust-red or even pink. I have sent a specimen of it to the Royal Geographical Society for identification. The rubble which composes the vast slopes of this worn-down plateau consists of stones of a dirty yellowish-white or Naples yellow, in some parts calcareous. I send a specimen of this also for identification. In some of these mountains the soil would appear to be full of lime. It is much eaten away by wind and rain-water into fantastic forms and caves. All this part of the Sahara undoubtedly consists of a flat tableland cut up into blocks (which continue to dwindle and crumble) by the action of water, and still more, in recent times, by the strong sand-laden winds, which triturate and rub down the surface of the rocks. Man has long inhabited this inhospitable region. Although it appears at first sight the most hopeless desert, water is nearly always to be obtained by sinking wells in the dry watercourses, or hollows between the ridges of plateau, or even on the high plateau itself. And these table-mountains with their steep sides formed natural castles and strong places, where man has added masonry so exactly in the style of the geological formation around him, that at a distance it is impossible to tell the natural castles and walls from the artificial. The most singular place of this description is the hill town of the Beni-barka. When I rode out to this extraordinary place with a French officer, I saw a steep-sloping mountain rising nearly to an apex; but the top of the pyramid, as it were, was cut off, and its place taken by a cap of masonry, a vertical wall so lofty that I found it difficult to realize it was the work of man. This town,

* It is, perhaps, worth remark that the peacock has been long domesticated in Tunisia, and is very cheap and abundant in the north

at a little distance, appears as difficult of access as the Matterhorn; nevertheless, the French military engineers have constructed a wonderful serpentine road round and round the pyramid of mountain, so that you can ride up to the entrance of the town on horseback. Here you dismount at a narrow, tortuous entrance, with immensely high red walls of many-storied buildings on either side. The upper stories of the houses occasionally communicate with each other across the street by palm-trunk bridges. By means of rough stone steps, one can mount to the flat roofs of some of the houses, and obtain the most wonderful views thence over the desert.

After spending a short time in the vicinity of Tatawin (I would strongly recommend to the tourist the fantastically picturesque town of Getoffa), I rode southwards to Dwirat, perhaps the most remarkable of

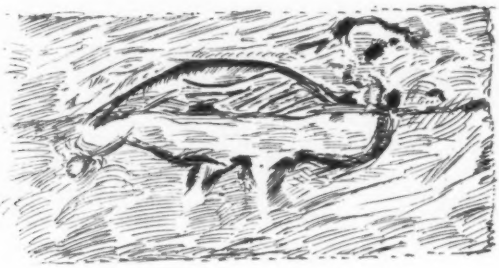


PEACOCKS (?).

these old Berber mountain cities. To save wearisome verbal description, I give a rough sketch of this remarkable place. The crag on which it is situated rises very abruptly about 1500 feet above the ravine, and about 3000 feet from the broadened plain below. My sketch, though accurate topographically, fails to render adequately the extraordinary effect of this precipitous mass of mountain and masonry, because want of space prevents my including the precipitous sides of the ravine. The effect that this and other agglomerations of Berber dwellings made on me was that of some ogre's or giant's castle of fairy tales. In these constructions it is often difficult to distinguish between nature's masonry of the layers of stratified rock and the prehistoric style of building with enormous blocks of stone which is still to be found here and there in these towns, though the modern inhabitants build with rubble and mud. The picturesque effect is enhanced by the simplicity and directness of the colouring. The sky, of course, is almost invariably a vivid ultramarine. The great mass of mountain, with its parasitic towns of masonry, is a uniform red-mud colour, which of course, under the setting sun, becomes *vieux rose*. Here and there stands out a saint's

tomb, or a modern mosque or sheikh's house, in vivid blazing white; but ordinarily the colour of the human settlements is so exactly that of the soil that, but for the black slits of the doors and windows which honeycomb the mass, you do not realize at first that you are looking at a town. The slender, spindly palm-trees that rise up from the ravines and valleys, have scalloped trunks of dusty grey, but their crowns of fronds contribute an agreeable note of glaucous green to the brown and blue landscape.

In Dwirat the inhabitants all talk amongst themselves a Berber language, which appears to be closely related to the tongue of the Tawarek of the Sahara desert. I append a short vocabulary of this. This is the first place one reaches, coming from the north, where Berber is openly and commonly talked, though, as I shall afterwards point out, Berber dialects are much more widely used in Southern Tunis than is commonly imagined. The sheikh of Dwirat told me that his town and



AN OSTRICH (?).

tribe were founded 950 years ago by an Arab, who came from the Tafilelt oasis of Morocco, married a Jerba woman, and settled in the Sahara desert on this inaccessible mountain. He assured me that the language of Tafilelt (which, of course, is a Berber tongue) was closely allied to the dialect of his people. On the other hand, the words I collected from him showed the great resemblance which exists between the dialect of Dwirat and the Tawarek language of the Sahara; and the chief himself admitted that his people could understand and make themselves understood by those fierce nomads who range between the southern frontier of Algeria and Tunis and the Sudan. An Arab from Tafilelt may have come to Dwirat 600 years ago, but he certainly found a Berber-speaking population in possession of the country. At Dwirat, as in all these mountain fortresses in the Tunisian Sahara, it is very quaint to see an enamelled-iron plaque with "bureau de postes" on it, and below "boite aux lettres," and these announcements on the wall of some rude dwelling like a robber's den. But, in the first place, the Berber populations have taken very kindly to French rule; secondly,

the French Government has had the wisdom to concede to them a large measure of self-government; and, thirdly, being a very enterprising race in matters of commerce, they thoroughly appreciate the advantages of postal service, which they manage locally themselves. At Dwirat the same sheikh (a handsome man of fair, ruddy complexion and almost European features) gave me much interesting information about the Sahara desert and the Sudan. In common with many other natives in this part of Tunis, he evinced a great interest in the countries of the Niger basin and Lake Chad. For some years past caravans have ceased to find their way into Southern Tunis, owing to the enmity between the French and the Tawarek; but occasionally an envoy comes through. For instance, the sheikh of Dwirat told me that a few months before a

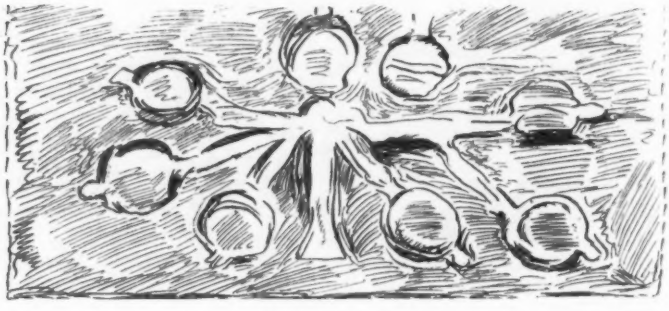
OSTRICH AND GAZELLE (?).

Hausa "doctor" had come overland from Sokoto (or, as the Arabs pronounce it, Suktu). From him he had learned that the English were regarded as the allies of Sokoto, and that they had recently come into the country with a large force of men, and had fought several battles.

At Dwirat, Shnini, and similar towns in the vicinity, exists the same unrecognized phallic worship that I have referred to in my remarks on the island of Jerba; but the phallic altars or temples are of still more marked form, and are kept more separate from the actual mosques. I give a drawing of a phallic altar on the high mountain ridge behind the peak of Dwirat. Questioned about these monuments, which are not of large size (perhaps at most 15 feet high from the ground), the people profess no knowledge of the meaning we ascribe to them; they simply say, "It was a custom of our ancestors to make monuments of this kind." Or sometimes they say that the altar marks the birthplace of a saint; or, again, they say, "It is a place of prayer." I was told that these

temples are generally sought after the feast of Ramadhan. They are usually a hollow cube of rough masonry, with the phallic emblem placed above the doorway. These temples are by preference placed on a height, on a striking peak or ridge.

From Dwirat I rode over a bleak moorland of plateau to another town of the most extraordinary appearance, called Shnini. On the way I caught a glimpse of profound gorges in the mountains, one of which reminded me of scenery I had seen in pictures of the course of the Takaze in Abyssinia. There was probably water in these profound ravines, as they supported a fairly luxuriant vegetation of palm trees, olives, figs, and pistachios. About 3 miles from the town of Shnini we entered the gorge of the Shnini river or watercourse, where water lay here and there in bluish pools. The sides of this "wed" were very precipitous, and the formation looked like a friable



POMEGRANATE TREE.

limestone, which the "wed" in flood had carved and scooped in a remarkable manner, forming little caverns, holes, and arched recesses. The forest of palms here was luxurious. Shnini is, in a sense, also built in terraces on the sides of a huge precipitous mountain (by the side, rather, of a cañon, which has been scooped out of the plateau by the agency of water). I say "in a sense," because, with the exception of a few houses and mosques, Shnini is not built at all; its dwellings are simply excavated chambers in the rock, furnished with doorways and windows cut in the rock wall, with here and there, possibly, a little masonry to render the wall of the dwelling tidier and more regular. The rock would appear to be some soft stone in consistency, and easily carved, though at the same time not given to crumbling. The sheikh's house, which I occupied, was a most spacious apartment, excavated in the mountain-side. Its floor rose in flat terraces; its height varied from 20 to 10 feet, with inner store-rooms still further cut into the bowels of the rock, with a higher floor and

lower pitch. The hard rock floor was like polished cement. Round the walls wooden pegs had been driven into the rock to hang up a variety of articles. The excavators had had the forethought, in their carving, to leave projecting blocks of stone, and these, with the niches cut into the surface of the wall, supplied the place of furniture—tables and shelves—while the steps of the terraces became seats or tables or beds. The floor was beautifully covered with rich-tinted carpets, and the interior displayed, on the whole, a well-developed æsthetic taste.

From Shnini I rode northwards to Ghumrasen—a "wed" with abundant water derived from wells, much irrigation, and consequently flourishing crops. Flat-topped crags and hillocks rise above the water-course. The most fantastic of these crags is surmounted by a pretty little white mosque. The principal settlement of Ghumrasen appeared

A LION.

to be of recent date as regards its architecture, the houses being built of rubble; but in the surrounding villages close at hand—in fact, visible from one point of view—were curiously illustrated three stages of early human dwellings. In the sides of one hillock, halfway up, were some remarkable caverns (scooped out by water, long ages past, in the calcareous soil), situated below a huge superimposed mass of horizontal stratified rock, the slopes of which acted occasionally as a natural roof to the hollow below. These caves were being inhabited by a number of nomad Beduins. On another hillside, what had formerly been natural caverns had been slightly enlarged in the interior, and the sides of their openings had been filled up with rude masonry to restrict the entrance. This, therefore, was an adapted cavern. But elsewhere man had deliberately carved and excavated the rock to form artificial caverns of rectangular shape.

Such woodwork as is absolutely necessary to the inhabitants of

this part of Tunis, is derived from rough-hewn planks of the date palm trunk or sections of the same, so the whole trunk may be used for columns or beams. The trunk of the date palm here and in the Jerid is also split into two, hollowed out, and used as conduits for water. The gnarled branches and trunk of the olive tree also furnish materials for rude implements of agriculture, such as ploughs. Doors are made of palm-trunks, adzed to a flat surface, or else split off by wedges. They have no idea of sawing planks, though they much appreciate such fragments of deal timber as come to them in the shape of boxes. All over this district the cutting out of huge round stones for pressing olive oil is a regular industry, the stone of this district and the adjoining parts of Tripoli lending itself to the purpose. These enormous circular stones—often nearly 3 feet in diameter—are pierced with round holes for the reception of the wooden turning-handle. In

A PINE TREE (?).

A FIGURE WITH RAISED ARMS.

addition to those stones that are made to-day, large numbers of others, identical in size and shape, are found on almost every site of former Roman or Berber settlements in the northern Sahara.

From Ghumrasen I rode to Howaya, another Berber market town, but one in which there were few dwelling-houses, the buildings being mainly corn stores, or "ksūr," similar to those I have described at Mednin. On the journey to Howaya, however, most of the hillsides were honeycombed with excavated houses, like those at Shnini, the existence of which at a distance was only indicated by the black slits of the doorways. The bare brown ridges of rocky mountain, thus punctured with the minute doorways of these human burrowings, has the appearance of a moth-eaten garment.

For Dwirat northwards I had been travelling over a great plateau, broken by watercourses and water-hewn valleys. This was gradually rising in average altitude as I journeyed northwards, while, from being

nearer to the zone of regular rainfall, the ground was less denuded of vegetation. So, after leaving Howaya, the general level of the ground rose still more markedly, and the vegetation increased until the country was entirely covered with short grass and shrubs and herbs. Around me was a panorama of gentle undulations, rising here and there into downs and rounded mountain-tops. The bare flat ridges of the Sahara mountains had quite disappeared, giving way to scenery resembling parts of Scotland. Though in a certain sense beautiful, with the rounded outlines of swelling downs, the varied tints of green vegetation, and the flying cloud shadows, which threw purple patches over the green, the landscape appeared to me peculiarly desolate. The eye ranged over an immense tract of country without the slightest sign of human habitation. I subsequently learnt that I had passed within a few miles of a village of troglodytes, whose dwellings were as usual inside the earth, and only marked by a doorway; but I saw nothing of man for a ride of some twelve hours, during which all traces of the route disappeared, and we lost ourselves in the immensity of the rolling downs of Matmata,* and in addition were drenched to the skin with a torrential downpour of rain. To the south of this district, it was said that rain had not fallen to an appreciable extent for four years. This plateau must either be more favoured in regard to rainfall, or else the mists coming up from the not far distant Mediterranean lie on the downs and refresh the abundant vegetation, so abundant in parts as to be a serious difficulty to our progress. At last we struck a tiny track which led us by degrees into a romantic stream valley, having in it trees of several kinds, and lower down clumps of date palms. The crags which rose above the watercourse were crowned with ruins of old Berber castles, and the remains of numerous dams in the main watercourse and the tributary runnels testified to former settlement and cultivation.

THREE HEADS.

But beyond a camp of Beduins we saw no inhabitants. An Arab from this encampment very civilly put us on the road towards civilization. It led us down the watercourse we had struck in its infancy. At last this debouched on to the great plain of 30 miles broad which stretches between the Matmata plateau and the sea-coast. The scenery in the foothills on the eastern versant of this Matmata plateau reminded me most strongly of parts of East Central Africa—the red soil, the dry watercourse filled with abundant vegetation, the acacia trees loaded with blossom, scattered date palms growing like the wild date palms of tropical Africa; the extraordinary solitude and the absence of inhabitants

* As the country is called.

recalled similar landscapes in the Kilimanjaro district, and to the north and east of Lake Nyasa. Of course, there was a very little real resemblance in the vegetation, which rather belonged to the Mediterranean types. The unreasonable zigzags of the paths were quite African in character, and after having laboriously descended into the plains we had again to scale the plateau, the ascent in some places being so difficult that our horses could scarcely clamber up. Late that night we arrived at a little village called Tujān, nestled on a ledge halfway up the precipitous sides of this now lofty plateau of Matmata. When we finally arrived at this welcome refuge we had been nearly twenty-four hours on horseback, without rest and without food, for our luggage and our other attendants had continued along the route which we had lost in the early morning. The "we" means my janissary, myself, and one native cavalryman.

I should like to say a few words about this little village of Tujan, as illustrating the results of the French occupation of Tunis. Its inhabitants, in common with all this mountain district, utterly defied the rule of the Tunisian beys, whose soldiers and officials probably never penetrated into the Matmata plateau. It is doubtful, indeed, whether this part of Tunis had ever been explored by Europeans prior to the arrival of the French, and any stranger arriving with a weak escort would almost certainly have been plundered, and perhaps massacred. Yet a few years pass, and without any warlike operations —at Tujan, at any rate—the country is entirely subdued by the presence of a few French soldiers in the plain as upholders of law and order (it must also be remembered that these military posts are mainly composed of locally recruited native soldiery); the Matmata plateau becomes almost as safe to travel in as France itself. For the attempt is made to appeal to the inherent reasonableness of the commerce-loving Berber race. A post-office under native management is established in every town and hamlet, and its "boite aux lettres" is the outward and visible sign of the stamp of civilization, a kind of fetish which appeals to the native pride. Respect for wandering strangers is impressed on the people, and the headman of every village and town (except where the French have themselves built such houses) is enjoined to build and maintain a rest-house, or "guest-house," for passing travellers. I arrived at this kind little village of Tujan at midnight. No word or notice had reached the surprised people of my coming. We had, indeed, to ride into the sleeping village with the risk of being attacked by the very zealous Arab dogs, and shout and knock at the doors of houses to rouse some one. The sheikh of the village soon made his appearance, and at once showed us the way to the guest-house, a poor little structure in rude masonry not yet completed, and with the wind whistling through the chinks between the stones. But already the house had been furnished with some preposterous Arab imitations of European furniture,

which reminded me of the thoughtlessly disproportionate tables and chairs with which we furnished our dolls' houses as children. The chairs in this case were small and squat; but the table was of such a height that it seemed to reach nearly to the ceiling, and I could never have lived up to it. Seeing I was quite worn out with fatigue, the chief brought a pile of carpets, which he folded to increase their thickness, and laid them on the mud floor, thus forming an extemporized bed, on which I laid myself gladly, and slept whilst supper was being prepared. It made its appearance at two o'clock in the morning, and consisted of *kuskus*,* a plate of dates, and, what I most enjoyed, a basket full of dried figs; the whole being wound up with cups of coffee. The next morning we started at daybreak, being provided with a guide. There was nothing to pay for the hospitality, and it was with difficulty that I pressed a small present on the acceptance of the chief, whose only request was that I should not complain of the meagreness of his hospitality.

After half an hour's arduous mountain-climbing, I reached the French post of Matmata Kabira, where there is a French officer of the Intelligence Department, who has under his orders a few native soldiery. Matmata a year ago had been the scene of a slight outbreak occasioned by the opposition of the natives to the new system of enforced military service. There were other grievances, however, more vivid, due to the maladministration of some native Tunisian employés, who unhappily cannot divest themselves of that Oriental tendency to plunder when placed in positions of authority over their fellow-men. But a new kaid, or native governor, had been appointed, and the district was now absolutely peaceful. At Matmata Kabira the plateau probably touches an altitude of 4000 to 5000 feet above the level of the sea. The plateau is carved here into ridges and downs. On one of the highest points of elevation, from which a magnificent view is obtained for 40 miles over the eastern plain, the French have built a fort and pretty houses for the European officer and his subordinates. After the savage desolation of the scenery southwards, it was a great surprise to find myself situated in a charmingly furnished dwelling at a most delicious breakfast, with a bright French lady as hostess talking to me alternately in English and French. It was extremely cold here at this time of the year, and a roaring fire was burning in the tiled grate. From the windows one had a view of yellow and blue immensity, as one might have had from the car of a balloon—the yellow being the sunlit plain, 4000 feet below the crag on which the house was built; and the blue, the hazy Mediterranean and the sky.

In the towns and villages of Matmata proper I met with another

* Crushed corn cooked in the steam of meat and richly flavoured; served with meat and vegetables.

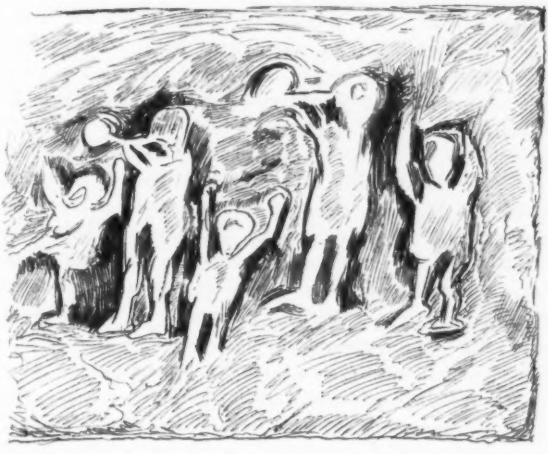
type of troglodyte dwelling—the most recent and the most developed of all. It will be remembered that I have already described other stages still existing in this country. First the natural cave, pure and simple; then the cave improved, with its entrance restricted by heaps of stones; next, the rock chamber, which man has deliberately excavated in the vertical mountain-side. But amongst the Matmata the fourth type of dwelling is the most elaborate of all. Here the people select in the mountain-side a flat piece of level ground. They commence by digging a great pit, which they finally shape into a rectangular well, usually square, and from 20 to 30 feet deep, with vertical sides. A little distance off they make a sloping tunnel, which leads by a very gradual descent from the upper surface of the ground to the floor of this well

A HARTEBEEST (?), SOME KIND OF ANTELOPE.

below. This tunnel is made sufficiently high and broad for the passage of camels. The central court of the dwelling, therefore, is reached from above ground by this long-descending passage, though it may also communicate directly with the upper surface by a long ladder or stone steps. From the central court other chambers and stables for the beasts are further excavated into the bowels of the earth. During the very cold winter weather in which I visited these underground houses, I found them so warm and dry that I thought they were artificially heated by braziers, and was surprised to find that there was no artificial warmth at all—merely that the temperature of the underground rooms remained pretty equable all the year round, being very cool in summer and very warm in winter. The soil which permits this easy excavation, and yet retains a marble-like consistency and does not crumble, must be of a peculiar composition. I was informed by a French officer that it was a mixture of clay and gypsum. This final development of troglodyte

architecture is said to date only from about 200 years ago. On all the crags and ridges round about Matmata are traces of abandoned dwellings of the older type excavated in the vertical hillsides; and again, far older than these, vestiges of castles built of large stones lingered on certain prominent heights. Amongst the Matmata I noticed no trace of phallic temples, so prominent to the south and east. The people here are said to still retain the use of a Berber dialect, though its existence is not so obvious as at Dwirat and Shnini, where it is the common tongue of the people.

Before quitting the Matmata country and descending into the plain (in my recapitulation of my journey), I might pass in review the leading physical characteristics of this interesting region.



MEN TRUMPETING, AND WOMEN (?) AND CHILDREN (?) DANCING.

South of the district of Gabes, at a varying distance of 20 to 40 miles from the shores of the Mediterranean, stretches a block of tableland south and south-eastwards to the Tripolitan frontier, where it seemingly joins the tableland of the Nefus. South of Dwirat, however, there is a break and a lowering of the general level, so that the Matmata plateau may be said to end southwards about here. This plateau, of course, is cut up, especially to the east and west, by deep gorges and valleys carved out of the friable soil by the action of rain-water, at a time probably when the rainfall was far larger than at the present day. In the central portion, however, the plateau retains a greater uniformity of surface, and there is an extent of about 50 miles long and 30 miles broad, where the eye ranges over rounded undulations of tableland of an average height of 3500 feet. In some parts, especially to the north and east, the

heights attained by the ridges and crags probably exceed 4000 feet. I am following approximately the heights computed by the French surveyors, but this region is as yet imperfectly mapped, and I should not be surprised to hear that recent investigation has established one or two points of the Matmata plateau at an altitude exceeding 4000 feet. The southern part of the plateau about Dwirat and Tatawin is much broken up, and is of a very "desert" character, vegetation being almost entirely absent on the mountains; but to the north, as the average altitude of the plateau increases, the ground becomes more and more covered with grass, herbs, and shrubs, until about the Matmata district proper it presents the appearance of a country well clothed with vegetation. Varieties of plants are not numerous. They consist chiefly of a strong-smelling shrub, with its leaves reduced to fleshy scales, resembling in growth a thuja, but with minute four-petalled yellow flowers at the termination of the stalks;* a wispy thing with broom, with no leaves and no flowers to define it by at this time of year; a leafless composite with white flowers like the wild carrot;† a glaucous grey bush with flowers like the camomile; *artemisia;* a bush with green flowers like the privet, but thorns and leaves in growth like a hawthorn; the rosemary, covered at this season with its pretty mauve-blue flowers; a coarse grass, growing in tussocks, and with a flower like a diminutive pampas grass; and the halfa or esparto grass. This latter is only found on the heights. The first three flowers mentioned are met with on the desert plains; the tamarisk grows near most watercourses, or wherever there is moisture in the soil; and on the highest parts of the Matmata plateau I noticed a conifer, which was apparently a species of juniper. I nowhere noticed the oleander, nor did I see a single specimen of the Aleppo pine, or any other conifer except those growing like the juniper. The Aleppo pine‡ and the oleander did not seem to grow in Tunisia south of 34° 30′ of altitude. In the river valleys of the Matmata plateau I noticed an occasional fig tree grows abundantly, though it is probably always cultivated or run wild. Olive trees were abundant wherever there was a slight moisture, but they seemed to be the cultivated kind. I think the wild olive does not reach so far south. As regards animal life, it is singularly scanty. The lion has long been extinct; the leopard probably exists no longer; the striped hyena and the ordinary North African jackal are fairly abundant. I heard of no lynx or ichneumon, nor did I anywhere hear of the Barbary ape.§ Jerboas abound. In the sandy desert to the south and west the addax antelope still lingers. The people of Dwirat and Shnini frequently make expeditions into the desert and hunt this animal, and a considerable trade is carried on with

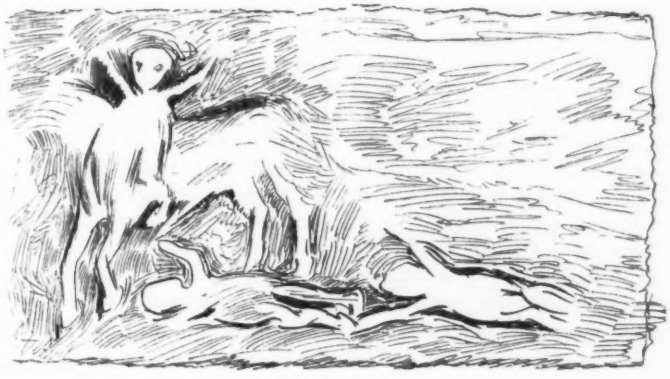
* *Thymelæa hirsuta* (they tell me at Kew).

† *Deverra scoparia.*

‡ *Pinus halepensis.*

§ Which seemingly is entirely absent from Tunisia and the Tripolitaine and Egypt.

the French officials and traders in its horns, which find their way northwards to be sold as trophies to tourists. I was nowhere able to hear of the so-called Tunisian hartebeest, and a German naturalist who had travelled in these parts, told me that the hartebeest is almost, if not quite, extinct in Tunis, and is only now found in Algeria and Tripoli; in the latter country it is still abundant. The hartebeest, he informed me, prefers slightly wooded hill country, while the addax, like all oryxes, frequents the sandy desert. The audad, or wild sheep (here actually known by that name *), I did not hear of in the Matmata country, though it is still fairly abundant further north, between Gabes and Gafsa, on the Algerian frontier, and in the hills of the Jerid. As regards birds, they were nearly as scarce as mammals, but more prominent in appearance. The Berber settlements were frequented by



A BATTLE SCENE.

a charming species of chat—the black chat (*Saxicola leucura*). This is rather a large bird for its kind—almost the size of a song-thrush—quite black except for its large tail, which is snowy white, and which it delights to spread out like a fan. The black chat is described in natural histories as being a very shy and retiring bird. In the Sahara, curiously enough, it is seldom seen away from human settlements, where it is as tame and as much at home as any sparrow. So tame are they, that I was enabled to make some drawings of them in their pretty postures only 2 or 3 feet away from them. The griffon vulture, the common kite, and various falcons are seen from time to time; there are bustards and coursers. The commonest bird of all is the crested lark, and the most rapacious the carrion crow. The ostrich now is never heard of,

* Or more correctly by the name of "udad."

though within the memory of men still living it was commonly met with. The French officers told me that snakes are numerous, and amongst them is found the Egyptian cobra.

As regards the human inhabitants, they are, linguistically, emphatically Berber; but the physical type is not uniform. There are a great many negroes amongst them from the Sudan, slaves and the descendants of slaves. There has evidently been some negro intermixture. As a rule, the people are handsome and of good stature; some of the men are strikingly good-looking, with clear complexions. I saw nowhere any trace of the so-called blond Berbers. I think a great deal of exaggeration has of late been bestowed on the fact that there are in the mountains of Algeria people of Berber stock who have red moustaches and brownish-black hair, together with grey eyes. From this fact certain anthropologists have started the idea that the blond races of Europe originated in North Africa. With the evidence at present before us, and seeing that the blond races with flaxen hair and blue eyes predominate in the north, north-east, and east of Europe, I think it far more likely that they had their origin in the adjoining countries of Eastern Europe. The presence of red hair (red moustaches and beards are commoner than red hair of the head) among some tribes in the mountains of Algeria may be much more easily explained by intermixture of the old Berber stock with European blood—perhaps with European immigrants who had taken refuge in the mountains—or by an independent outbreak, so to speak, of red hair and grey eyes, which I believe occasionally occurs quite independently in various races, either as the sport of nature, or as a reversion to some red-haired species among the human progenitors. There have been countless invasions of North Africa from Europe, from prehistoric times down to the present day. There have equally been invasions of Europe by the North African races, which have far more profoundly affected existing European populations than the counter-invasions of Europeans have influenced the existing races of North Africa. If I may seem to speak with some dogmatism on this subject, I should like to state in extenuation that the journey I am now describing is not the first I have made in North Africa. I am fairly well acquainted with the whole of Tunisia, and with some parts of Algeria. As to the origin of the dark-haired Berber races, I still hold to the opinions expressed by me in my 'Life of Livingstone and the Exploration of Central Africa,' where I gave a synopsis of the Berber origin and the relationships of the African races. I believe the Berbers, in common with all other Hamite peoples, and with the Arabs and some other Semites, have sprung originally from a Negritic stock.

After leaving the Matmata plateau, I descended into the country of the Jerid, and stopped at El Hamma, a congeries of villages in a fine oasis of palms, not far from the shores of the Shat-el-Fejej. In this

district there are many towns and villages called El Hamma. This is an Arab word (seemingly) meaning "heat," "fever." It always indicates the presence of hot springs. The whole of the Jerid country, from near Gabes on the east to beyond the Algerian frontier on the west, and from the southern shores of this dried-up salt lake on the south to the district of Gafsa on the north, is permeated with hot springs welling up from the sand or the sandstone formation.* The water is sometimes medicinal in character, being impregnated with various salts; sometimes it is quite fresh and potable. Its temperature varies from near boiling-point to tepid. The water is invariably pellucid, but sometimes has a faint bluish tint which is indescribably beautiful where the water lies in deep cisterns. The Romans were quick to appreciate the value of this gift of nature, and the whole of

TWO HORSES, AND MAN ON HORSEBACK WITH SHIELD (?).

the Jerid abounds with remains of their settlements. Almost every important spring has relics of Roman baths. At some places, as at the El Hamma, near Gabes, and especially at Gafsa, the Roman baths are used to this day by the natives, though in a state of considerable disrepair. The French have had the good taste to leave almost untouched (except as regards protection from further ruin) these interesting monuments; but where the spring is sufficiently important, as at El Hamma, they have built in a separate place modern bath-houses for both Europeans and Arabs, and often for men and women of both races. The baths of El Hamma are said to be marvellous as the cure of rheumatism and similar ailments. It is not advisable to stop in more

* I forward with this paper two specimens of rock taken from the geological formation where these springs abound. Some expert may be able to supply the Society with a proper definition of its character. In a vague way I term it "sandstone," because it is very friable, and the action of the wind breaks it into sand.

than five minutes. One feels parboiled, and leaves the bath with the sensation of having had a vast mustard plaster applied all over one's body, and a face in hue as the boiled lobster. Very often perfectly salt and perfectly fresh springs will rise within a few feet of one another. At Tuzer, which I afterwards visited, there are salt rivers and fresh rivers, with the result that the natives end by drinking a kind of amalgam of the two. All these streams, after being utilized for baths, are dispersed in natural and artificial channels through magnificent oases of verdure—a veritable garden of the Hesperides. So well utilized is the water that but little of it reaches its original destination—the *shat*, or dried-up salt lake. The country around these shats * is of such desert aridity that the dense forests of date palms which mark the sites of each oasis are enhanced in their effect of shade and verdure. All the Jerid is a most picturesque country from the artist's point of view. The bare mountains of fawn-coloured sandstone assume at sunrise and sunset the most lovely rose tints I have ever seen. Some of the hills which are calcareous and whitish rival at these times the sunset glow on snow-fields. The arid nature of the soil is rather agreeable to the eye from its monotonously warm tint as contrasted with the glowing blue of the sky and the varied greens of the oases. The outlines of the mountain ranges are remarkable, and are best illustrated by the accompanying sketch, which is no exaggeration of the strange regularity of these serrated ridges or of their curious crumplings. The rainfall in the Jerid is very slight, except in the vicinity of the coast; yet these inexhaustible springs in some places maintain ever-flowing rivers, as, for example, the river of Gabes, the river of Kebili, the many streams at Tuzer and Nefta.

The ancient Roman-Berber town of Gafsa is situated on a broad river-bed, which is seldom without a thin running stream, though this river is of considerable length, and starts in the mountains on the borders of Algeria. The shats, or salt lakes, of the south of Tunis are rather a disappointment to the traveller. On the map they promise so much in the way of expanse of water, and in reality all one sees is a flat plain of hardened mud, with a few streaks and pools of stagnant water and stretches of white salt incrustation. It is probable that these shats were at one time connected with the sea near Gabes. Some portions of their bottoms are said to be below the level of the Mediterranean, though not to the extent originally stated by those engineers who talked of letting the sea into the south of Algeria. Apart from the diminished rainfall, man has been the principal agent for the last few centuries in the drying-up of these salt lakes by intercepting the

* "Shat" (pronounced like the English word "shut") is the correct spelling; not "schott," which our geographers so love, following blindly the French spelling. *Shat* is an Arab word meaning "lake," "sea." Compare "Shat-al-Ārab," the joint Euphrates-Tigris estuary.

water of the innumerable hot springs, and spreading it out in such elaborate irrigation of the desert that very little of it reaches the lake shores. The heavy showers which occasionally fall in the late autumn make these shats too muddy to be passed by man or beast; otherwise, in the dry season of the year, they are traversed as one might traverse a slightly marshy plain. Their appearance from a distance varies according to the degree and angle of sunlight. On a dull day the traveller looks down from the heights on a perfectly flat plain of mud-colour, and sees no shat; on another occasion, when the sun strikes the salt incrustation and the thin sheets of rain water, the appearance then is something like a lake. Yet the view is rather grand from Tuzer or Nefta. One looks eastward over a perfectly flat surface, which gives one an extended horizon, level as the horizon of a sea. Far away to the right and to the left stretch the encircling mountain ranges 40 miles

SCROLL-WORK (? WAVE PATTERN).

apart. With the aid of an occasional mirage and the refraction from the salt, the effect is that of a vast expanse of water, a gulf which might communicate with the Mediterranean.

"Jerid" means in Arabic a palm frond. It implies a forest of date palms. I am of opinion that the date palm—belonging to the African genus *Phœnix*, with outlying relations in Western India—is indigenous to the Sahara Desert and Arabia, and is a relic of the days when the Sahara was a well-watered region, with a continuity of flora and fauna with those of tropical Africa. The date palm therefore grew wild in the south of Tunis as far north as 34°, and undoubtedly was the real lotos of the Greeks. The ancients were far more easily pleased in the matter of fruits than ourselves. We should find the original fruit of the wild date palm very poor eating—no better, in fact, than the fruits of other wild species of *Phœnix* which abound in Central Africa. But to the Greeks it must have seemed deliciously sweet-eating in comparison with the crab apples and wild plums to which they were accustomed. The Romans cultivated date palms in their South Tunisian settlements, but not to anything like the same extent as the olive and the fig. Until about four hundred years ago the staple cultivation of

the Jerid was the olive tree, but at that period the olive was given up in favour of the date, at that time growing practically wild; and these districts round the salt lakes of Tunis now produce the finest dates in the whole world. Some notes on the cultivation of dates will be found in my commercial report to the Foreign Office, so I shall not give them here.

The Arab conquest of the Jerid brought about the ruin of the Roman cities, but the fatness of the country soon encouraged the revival of civilization. At Tuzer there must have been a remarkable development of Saracenic art in the twelfth and thirteenth centuries. There are details in some of the ruined and abandoned mosques as exquisite as anything I have seen in Spain or Egypt. I am going to illustrate some of these shortly in the *Graphic*. The modern architecture of the Jerid cities is peculiar in that thin bricks are almost wholly employed, and are arranged in such a way as to execute fantastic and often beautiful designs. This phase of brick decoration extends westward into the Algerian Sahara, and even, I believe, penetrates to the verge of the empire of Sokoto. The people of the Jerid suffer very much from that parasitic affection of the eyes which is so common in Egypt; otherwise they would be a handsome race. They are free from fanaticism, kindly, and polite, and their commercial aptitudes have led them to welcome the arrival of the French. Throughout all this country one is singularly safe, and the French maintain law and order with but a handful of police. Much credit, however, must be given to the officials whom the French Government has had the wisdom to place there—men of tact, with a good knowledge of Arabic, who are without fussiness or undue assertion of their authority.

As regards the fauna of the Jerid, mammals are numerous. There are the striped hyena, the jackal, the fennic fox, a hare, numerous rats, and jerboas, the porcupine, the wild sheep (Audad), a few lingering specimens of the addax antelope, the wild boar, and a species of gazelle.* Amongst birds are said to be found two or three species in the palm forests characteristic of Senegal, such as the *Turtur Senegalensis*. There is one bird here which (I write under correction) is unknown to me, and seems to be peculiar to the Jerid country. It appears to be a species of bunting, but has a blue-grey head and breast, with black striations, and a chestnut body. The effect at a distance is that of azure and chestnut. This charming little creature, which the Arabs call "Bu habibi" ("father of my friend"), is of extraordinary tameness, and frequents the environs of houses with a winning friendliness.

Gafsa, to the north of the Jerid, is an ancient city of great interest and great picturesqueness. This paper is already too long and my time is too short to deal with a description of Gafsa, which, indeed,

* I am also informed that the cheetah and the Caracal lynx are found in the desert country south and south-west of the Shats. I often saw cheetah skins for sale here, and at Tripoli.

comes more within the ordinary range of the tourist. From Gafsa I made my way north, through scenery of ever-increasing interest, to Feriana, a place about which, not papers, but volumes might be written, so remarkable is the interest of its Roman remains. Here one felt in touch with the north. Indeed, the Sahara region really comes to an end at Gafsa, and one slowly mounts to the tableland of Central Tunis, where you are in a country that does not differ much in appearance and products from Southern Spain. To all this country north of Gafsa and Sfax the date palm is a stranger, except where deliberately introduced by man—it is absent, that is to say, from the wild landscapes; and on the hills the Aleppo pine begins to appear. Few experiences in my many years of travel have been so delightful as the abrupt transition from the regular Sahara Desert scenery round Gafsa to the Swiss-like mountains on the frontier of Tunis and Algeria. In this latter district, gentle mists swept over the hills, the air was thick with the aroma of the pine trees that covered the slopes in an almost unbroken mass; snow lay on the higher peaks and ridges, and purling streams meandered through turfy glades, or dashed in cascades over deep chasms. The scenery here was quite Alpine, and its resemblance to Switzerland was further enhanced by the splendidly engineered road along which we wound through the mountains.

I can strongly recommend South Tunis as a winter resort for tourists who do not mind roughing it in a very moderate degree. (I may mention, by-the-by, that you can bicycle almost everywhere, thanks to the roads which the French have made.) The hire of horses and camels is cheap; but, except at Gafsa and Gabes, there are no hotels, though the French Government have built along most of the main roads good rest-houses, which in all essentials are equivalent to hotels. In all the district of the Matmata plateau, however, there are neither rest-houses nor hotels, and persons who desire to explore this interesting region should provide themselves with tents and provisions. The French officials are most hospitable, but this fact should not lead tourists to constitute themselves a charge on men whose means are naturally limited.

VOCABULARY OF WORDS IN THE BERBER DIALECT OF DWIRAT (TUNISIAN SAHARA).

English.	Dwirati.
one	ejjen
two	sen
three	tlata
(And the rest of the numerals as in Arabic.)	
man	ariaz; *plural* eriazen
woman	tamtat; *plural* alχalat
child	afroχ; *plural* adderati
daughter	tafroχt; *plural* tifraχ

English.	Dwirati.
head	eχfin ; *plural* eχfaun
eye	teit ; *plural* tetawin
nose	tinzert
mouth	ɪme
teeth	*plural* sinin
tongue	elsen
neck	takramt
hand	fūsin
arm	fūs
ear	amzor ; *plural* imzarı
leg	dareq
foot	dareq
hair	zan
ox	afunas
cow	tafunast
horse	yis
mare	tralid
camel	alγum
female camel	talγumt
goat	aslan } *joint plural* maaz
female goat	teχsi }
sheep	birkus
dog	aidi
bitch	taidit
lion	(same as in Arabic)
mouflon (wild sheep)	Udad (*our* "Aoudad")
pigeon	aitbir
water	aman
rain	amzar
bread	aγu
fire	timsi
dead	immit

NOTE.—In the foregoing the Greek letters χ and γ (gamma) stand for the guttural sounds inadequately expressed by *kh* and *gh* (Arabic خ and غ).

NOTES ON SPECIMENS COLLECTED BY SIR HARRY JOHNSTON. BY E. T. NEWTON AND J. J. H. TEALL.

1. Rock from mountains of Tunisian Sahara.

Dolomitic limestone.

2. Rock from mountains of Sahara, South Tunis.

Limestone stained a deep red colour with ferric oxide.

Under the microscope this rock is seen to contain many fragments of shells, all of which are very much altered and decomposed. They appear to belong to lamellibranchs and very thin-shelled gasteropods. A few quartz grains are also present.

3. Rock from the Jerid (Region of the Shats).

This appears to be a "coral rock." It is very largely made up of organic remains, including foraminifera (amphistegina, etc.), pieces of the tests and spines of echinoderms, fragments of coral, and possibly nullipores. A few quartz grains also occur.

4. Same locality—similar rocks.

RESEARCH IN THE NORTH ATLANTIC.

His Excellency, Count Lewenhaupt, the Minister for Sweden and Norway, has forwarded to the Society for publication the following Memorandum, which has been presented to the Foreign Office, on the desirability of further international research in the North Atlantic:—

MEMORANDUM.

The following members of the Swedish Hydrographic Commission—Prof. Aug. Wijkander, Mr. G. Ekman, and Prof. Otto Pettersson, who have, at the expense of the Swedish Government, executed a series of scientific observations in the waters lying around the Swedish coasts—have addressed a petition to the Swedish Government, that invitations may be sent to the governments of Great Britain, Norway, Denmark, and Germany to organize, according to a common scheme, a research into the chemical, physical, and biological conditions of the water in the North Atlantic, in the North sea, and in the Baltic, especially with regard to the fishing interests; and in the hope that this proposal may be accepted, they have further proposed that, in such case, H.M. King Oscar II. may call a conference of one or a few persons from each country, to elaborate a common plan for the division of the work, to be afterwards submitted for approval to the respective governments.

In support of these proposals, they have made the following statements:—

At the Congress for Natural Sciences held at Copenhagen in 1892, an arrangement was made between the Swedish and Danish hydrographers to organize a common research concerning the hydrographical and biological conditions of the sea; and in this research Prof. Krümmel, of Kiel, also took part by executing, during several years, deep-sea soundings in the Baltic.

Later, in the years 1893–1894, the governments of Great Britain, Sweden, and Norway made, according to a common scheme and during all seasons, a contemporaneous research in the North Atlantic, in the North sea, and in the Baltic, especially with regard to fishing interests; and the scientific and economic results obtained by these several researches were such that the Sixth International Congress, held at London on August 3, 1895, decided to record its opinion "That the survey of these areas should be continued and extended by the co-operation of the different nationalities concerned, on the lines of the scheme presented to the Congress by Prof. Otto Pettersson."

This scheme is founded on the opinion that all fishing in the North Atlantic, and especially the presence of the migratory fishes, depends upon the great currents in the upper layers of the sea, and the variations of the presence in these layers of the food required by the

fishes, viz. "Plankton," or organisms of animal or vegetable origin floating in the water. A knowledge of these currents, and of the quality and quantity of the food which they contain, is necessary in order to determine the legislation required for the creation of a rational organization of the fisheries.

In consequence, a research ought to be made concerning the existing conditions, and the currents during all seasons, in the upper layers, between the surface and a depth of about 400 to 500 fathoms, as well as concerning the nature and the quantity of the "plankton" to be found in these layers. The best way to make the research would be to divide the area between the participating countries, in order that each country might establish a system of observations over a certain area of the adjoining sea. For Sweden, it would, for instance, be most convenient to explore the middle parts of the Baltic and the Skagerrack.

The necessary expenditure for a research of this kind would be comparatively small for each country. The research is less difficult when the intention is not to explore the deepest, but only the upper layers; the methods actually used for the observations are also less complicated than previously, and, as a result of the experience already acquired, it is now possible to avoid useless work by concentrating the observations upon essential points. Almost all the countries on the North Sea have now—with the exception of Sweden—established on their coasts scientific stations and institutes to make observations with regard to fishing interests.

Private associations are also found everywhere for this same purpose, and if all these institutions, which are now working without any common plan, could be persuaded to devote part of their work to a great common purpose, a great part of the object pursued could thereby be attained. The time for the research ought to be extended to five years. The observations ought to continue during all seasons, and as a convenient date to begin, May 1, 1899 or 1900, might be selected.

If the respective governments should feel inclined to accept this scheme, it is proposed that similar invitations ought also to be sent to the other countries situated on the Baltic and on the North sea. As the object of this proposal is only to make observations with regard to the fishing interests, it is not proposed to make any common exploration of the deepest layers. Such explorations, which are of purely zoological interest, cannot be made without great expense, and they ought not to be considered obligatory.

London, April 23, 1898.

In connection with the above, the following paper by the distinguished Swedish oceanographer, Prof. O. Pettersson, of Stockholm, is of interest:—

On the Influence of the Temperature of the Surface Waters of the North Atlantic on the Winter Climate of Northern Europe.

By Professor O. Pettersson.

At the meeting on July 31, 1895, of the Sixth International Geographical Congress in London, I had the honour to lay before the scientific authorities of meteorology and oceanography there assembled an account of a remarkable correspondence, which I had found to exist between the average temperature of the air in Scandinavia in the winter months, January and February, and the temperatures of the Atlantic surface-water, as recorded by the serial observations at Færoe, Iceland, and the Norwegian coast-stations. A paper upon this subject was published afterwards in the *Meteorologische Zeitschrift*,* wherein I showed that the warm-water area (*i.e.* the Gulf Stream) of the North Atlantic is liable to variations of temperature from one year to another. These variations are of little amplitude—the greatest differences in the sea-temperatures at the Norwegian coast in the month of January, from 1874 to 1892, do not amount to more than $+2°{\cdot}9$ F. and $-2°{\cdot}0$ F. from the mean value—but seem, nevertheless, to exert a great influence upon the winter temperature of North Europe, so that a relatively small surplus in the temperature of the ocean in January and February is accompanied by a great excess of up to 9° or 11° F. in the mean temperature of the air in Orebro, Upsala, and other places in Sweden; and likewise a deficiency of only 2° in the water-temperature is followed by a depression of the air-temperature amounting to 7°, 9°, or 11° F. beneath the mean.

This seems to indicate that the character of the winter in North Europe is influenced by relatively small variations in the distribution of heat in the upper layers of the North Atlantic. These small oscillations in the temperature of the surface water are, however, very powerful in their effect upon the state of the atmosphere, on account of the great capacity for heat inherent in the layers of warm and salt water which the Gulf Stream spreads over the Norwegian Sea and North Sea. Before 1893 nothing was known about the state of these parts of the ocean in winter. From the time of the International Hydrographic Co-operation in 1893 and 1897, we have some extremely important deep soundings executed by Mr. Dickson, on board H.M.S. *Jackal*, in the Færoe-Shetland channel and adjacent parts of the North Sea in August, 1893, November, 1893, and February, 1894, from which I have drawn the following diagram (Fig. 1), representing the distribution of heat in summer, autumn, and winter in that part of the ocean. It must be observed that the uppermost layer of water is entirely homogeneous, with regard to its salinity, from the surface to a depth of 100 to

* "Ueber die Beziehungen zwischen hydrographischen und Meteorologischen Phänomenen," *Meteorologische Zeitschrift*, 1896, 8 (August).

150 fathoms, so that the vertical thermic circulation caused by the contact of the warm Gulf Stream water with the colder atmosphere acts freely throughout the entire bulk of the warm-water layer. A cooled water-particle will thus sink until it reaches a layer of its own temperature, and another particle of warmer water will ascend from the depth to fill its place. The diagram (Fig. 1) shows that there exists a superficial stratum 25 fathoms thick, heated to about 54° F. in August. From that time until November the heat stored up in this layer is given up to the atmosphere. From November to February the vertical connection extends from the surface to the entire depth of the Gulf Stream

Fig. 1.

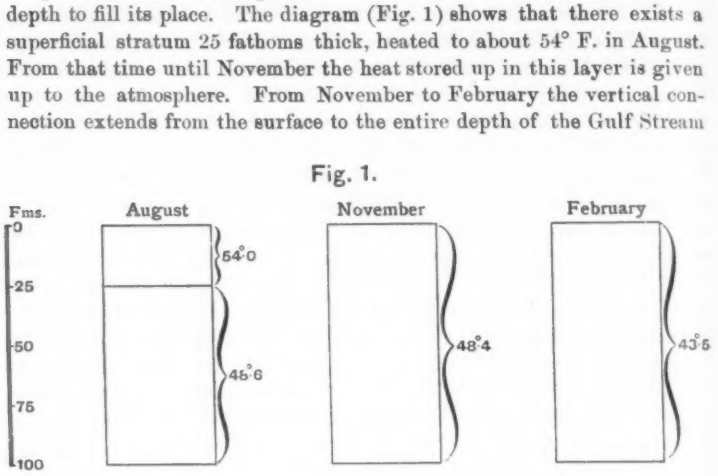
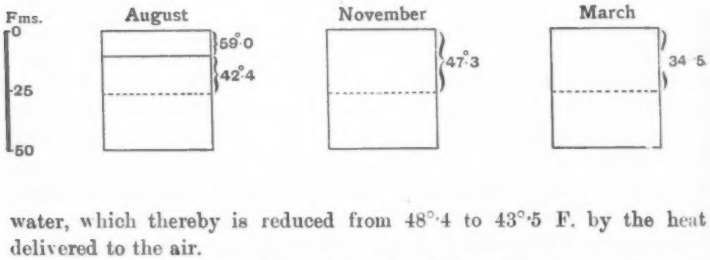


Fig. 2.



water, which thereby is reduced from 48°·4 to 43°·5 F. by the heat delivered to the air.

The second diagram (Fig. 2) I have deduced from our own deep soundings in the Baltic. Here the superficial stratum which supplies the store of heat during autumn is not more than 10 fathoms thick, but is nevertheless very effective, as it is intensely charged with heat (up to 59° F.). The long and mild autumnal season, which is peculiar to the climate of the Baltic islands, must be due to the heat thus stored up in the water. After this store of heat has been delivered to the atmosphere, *i.e.* from November, the vertical convection extends deeper to about 30 fathoms, or to the upper limit of the salt bottom water, which, on account of its higher density, stops the thermic convection. Thereby

the Baltic water becomes so exhausted of heat that its temperature in March has sunk to 34°·5 F., which is still high enough to prevent the freezing up of the sea in hard winters. In a mild winter, as that of 1897–98, the water-temperature does not sink so low as to 34°·5 F. The last Swedish deep sounding, March 19, 1898, showed that the temperature from the surface to 30 fathoms depth in the Baltic, east of Bornholm, was 37°·4 F. It takes a great time of the spring and summer to restore to the Baltic water the heat lost in the winter. Thereby the seasons of the year are retarded in the Baltic islands and in the countries surrounding the Baltic.

The heat given up to the atmosphere by the areas of warm water in the Norwegian Sea and the North Sea saturates the air with moisture, and gives birth to the great regions of barometric depression which were found to exist in winter over the northern parts of the Atlantic by Hoffmeyer.* It is easy to see that a difference of $+2°$ or $-2°$ F. from the mean temperature of the Gulf Stream area in the North Atlantic in winter will increase or diminish the heat which is delivered to the atmosphere by some hundred thousands of heat units per square foot, or 20 to 30 per cent. of the available quantity.

This view of the matter seems to militate against the recent meteorological theory, which seeks the *vis movendi* of cyclones in the upper strata of the atmosphere. The difference seems to me, however, to be only apparent. It must be remembered that this theory is based upon an elaborate study of the continental (especially the alpine) cyclones. We must distinguish between the permanent barometric depressions which form over the North Atlantic in winter and the wandering cyclones that sweep over the continents. The former are sustained by an incessant supply of energy from the warm areas of water beneath; the latter are whirls detached from their root and origin, which soon must perish unless they are reinforced by a new impetus from the breeding-place of cyclones—the ocean. That the range of temperature and humidity from below upwards can be reversed (as was found to be the case in the Alps) in a cyclone, which is dying out and consumes its own store of energy, is not more than we ought to expect.†

In the years 1896 and 1897 G. Ekman and I tried to keep account of the changes in the surface water of the sea south and west of Spitsbergen. Fragmentary as our observations necessarily must be, they bear out the following facts:—

A decrease in the flow of the Gulf Stream through the Norwegian

* N. Hoffmeyer, 'Ueber die Luftdruckvertheilung in Winter,' *Zeitsch f. Meteorologie*, Bd. xiii. and xiv. (1878).

† This matter is treated from a mathematical point of view in a paper by Prof. W. Bjerknes, "On a New Theorem in Hydrodynamics and its Application to the Movements of the Atmosphere and the Ocean," read to the Swedish Academy of Sciences, April 13, 1898.

Sea takes place in winter, followed by a reflux of the arctic water from higher latitudes, which partially overflows and thereby diminishes the warm-water area open to contact with the atmosphere. This can be proved partly by our own observations west and south of Spitsbergen* in May, June, July, October, and November, partly from the soundings of the Norwegian hydrographer, Dr. Hjort,† between Norway and Iceland in March and May, 1896.

The impact of arctic water upon the Gulf Stream area comes partly from north and partly from north-west, *i.e.* from the sea between Iceland and Jan Mayen. This invasion of cold Arctic and west Atlantic water in the winter months seems to rule the migrations of the cod towards the Lofoten banks and fjords, and of the winter herring into the Skagerack. We have certain reasons to suppose that the great periodical herring fisheries on our coasts in winter is due to a flight of the fishes from such parts of the sea where the conditions are rendered unfavourable by the intruding Arctic water. One of our reasons for this hypothesis is that, whenever the waters of the Baltic current, which in winter is as cold as the arctic current, accumulate on the Swedish coast-bank, the herring likewise immediately disappears and seeks shelter in the warmer waters of the open Skagerack.

The Gulf Stream, so far as it is a surface stream, keeps up an almost constant temperature of 41° to 43° F., even at the highest latitudes, where it is in contact with the atmosphere; while the surrounding arctic water, which partly overflows the Gulf Stream, rapidly decreases in temperature in winter into 36°, 34°, and 32° F.

The conditions of the atmosphere, with regard to barometric pressure and temperature over the Norwegian sea, closely follow the changes in the condition of the surface water, so that the warm-water area becomes the seat of a barometric depression. The isobaric lines on the meteorological charts follow the isotherms and isohalines of the surface water.

During the summer of 1896, and still more in 1897, there existed a remarkably strong flow of the Gulf Stream towards the shores of Spitsbergen and into the Barents sea. To this is due the success of the voyages of the Jackson expedition, of Colonel Feilden and Mr. Pike in these seas during last summer. Our observations show that in July, 1897, the Gulf Stream area extended over the entire distance between Norway and the north-west part of Spitsbergen:—

WATER-TEMPERATURES BETWEEN NORWAY AND SPITSBERGEN.

From July 14 *to* 16, 1897.

Norway.									Spitsbergen.
49·2,	47·0,	47·0,	46·2,	46·0,	47·0,	45·3,	45·3,	42·3,	42·2,	42·2,	42·0,	41·5.

* "Die hydrographischen Verhältnisse der oberen Wasserschichten des nördlichen Nordmeeres zwischen Spitsbergen, Grönland und d. Norwegischen Küste," *Bih. K. S. V. Handl.*, Bd. 23.

† "Undersögelse over organismerne og strömforholdene i det Norske Hav." From *Naturen*, Bergen, 1897.

Still more unexpected was the discovery that this strong flow of the Gulf Stream in these northerly latitudes continued almost unabated in November last year :—

WATER-TEMPERATURES BETWEEN NORWAY AND SPITSBERGEN.

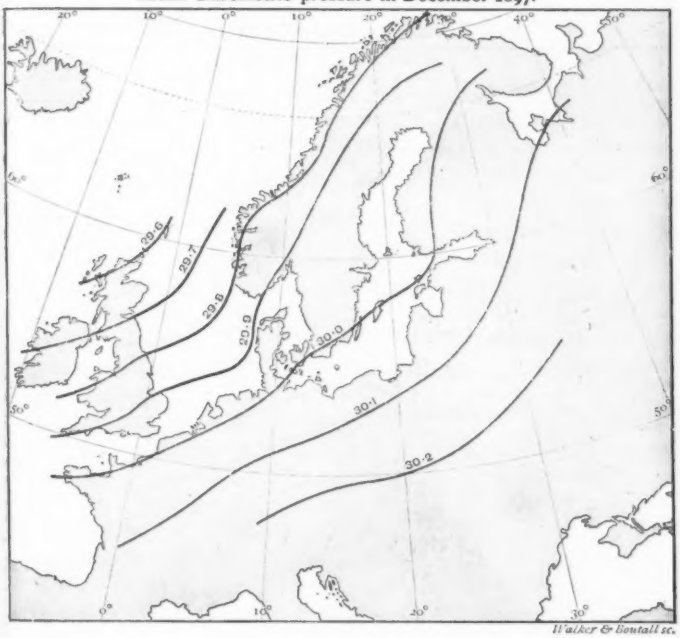
From November 8 to 10, 1897.

Norway. Spitsbergen.

44·6, 44·6, 43·7, 43·5, 43·2, 43·2, 42·8, 42·8, 42·8, 41·8, 37·9, 39·1, 37 5.

Simultaneously with this series of observations, another series of

Mean Barometric pressure in December 1897.



surface temperatures was taken between Cape Farewell and the Orkneys, with the following result :—

WATER-TEMPERATURES BETWEEN CAPE FAREWELL AND ORKNEYS.

From October 28 to November 6, 1897.

Cape Farewell. Fair island.

41 9, 43 2, 44·6, 46·5, 49·5, 49·1, 50·9, 50·0, 50·0, 51·8.

From this we may infer that the warm water of the Gulf Stream at the close of November, 1897, extended over the Atlantic and the Norwegian Sea from the 59th to the 75th degree of latitude. This

great area of warm water, which may have occupied a space of from 80,000 to 160,000 geographical square miles (English), has evidently given birth to the great barometric depression over the Norwegian Sea, indicated by the lines of mean atmospheric pressure at 8 a.m. delineated in the preceding chart.

In January, 1898, the warm area seems to have undergone some alteration, since the isobaric lines for that month in the following chart do not run parallel to the coast-lines of the Norwegian sea, but show a trend from west to east, indicating that the centre of the depression was then situated north-west and north of Norway :—

Mean Barometric pressure in January 1898.

The cause of this change of position may be twofold. First, we must bear in mind that the Gulf Stream water is moving northwards constantly; and, secondly, it seems probable that from the sea between Jan Mayen and Iceland the Arctic current has impinged upon the Gulf Stream, and inundated the southern part of its area. Be this as it may, it seems to be certain that the extremely mild nature of last winter must be due to the extraordinary hydrographic conditions which have existed in the Norwegian Sea.

It will be of importance for meteorologists in future to ascertain the size, the depth, and temperature of the Gulf Stream area in this part of the ocean, from which we may probably forecast the character of the coming winter. This can be done by means of a few soundings and surface observations executed in the autumn (September), and at the commencement of the winter season (November).

NORTHERN RHODESIA.

I. THE CHOMA DIVISION OF THE MWERU DISTRICT.

By HECTOR CROAD.

The Mweru district lies east of Lake Mweru, and stretches along the boundary of the Congo State. Choma station is, roughly speaking, half-way between Lake Tanganyika and Mweru, and is close to the Belgian line; its native name is Gansenga, and it is on the west bank of the Choma river, which loses itself in what is called the great Mweru swamp. Choma is the British South Africa Company's station, from which this part of the district is administered; an assistant collector is stationed here, who is under the collector at Rhodesia station, on Lake Mweru. The Choma division stretches from the west side of Mkula's village (Mkula is in the Tanganyika district), and, coming along the Belgian boundary, takes off to the south, along the west side of the Mweru swamp. The Choma is the only permanent river in this part; the other streams, though running well in the rainy season, nearly dry up in the winter, but have pools in places along their courses.

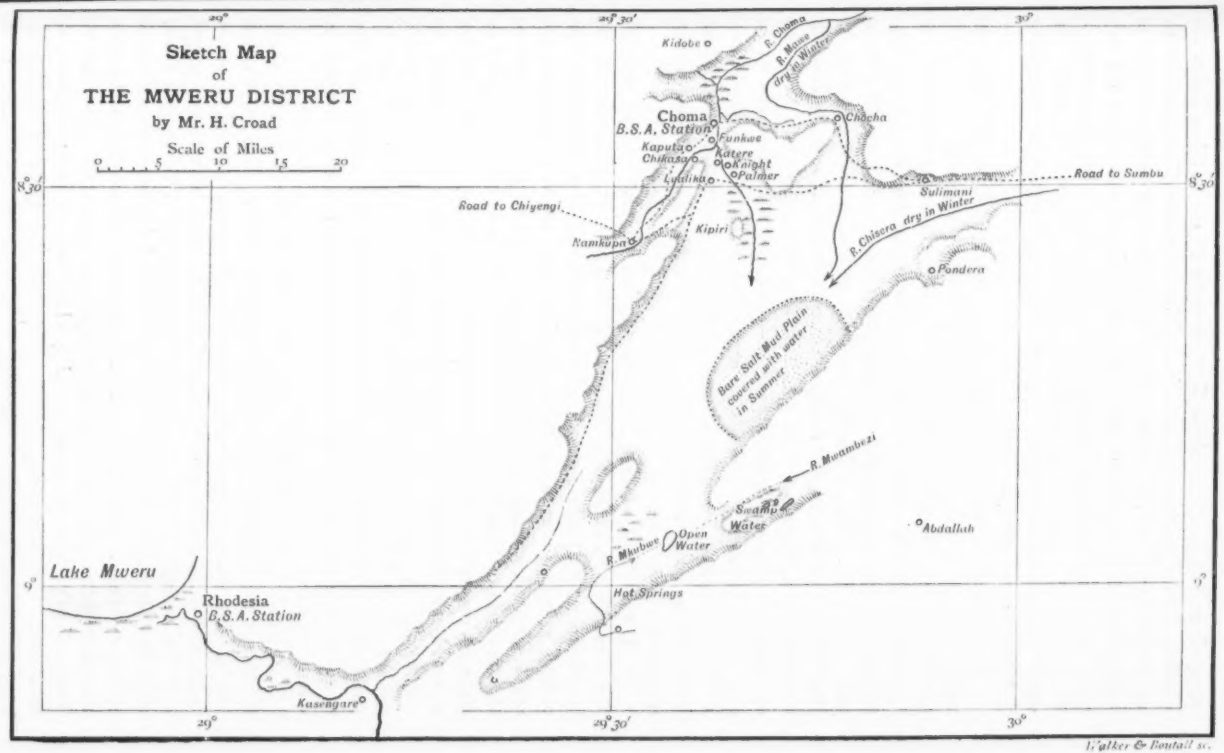
The road from Tanganyika, after leaving Mkula's, skirts the plain along the course of the Chisera stream. There is a village called Simwena's on the south side of the Chisera, a short run from Mkula, and the old road used to cross the stream here through a small swamp; there are generally a lot of hippo between this and Mkula's. The present road goes along the north side, and comes past Sulimani's village, who is the son of the old Mkula. Mkula built this as a sort of hunting-box, as it was a splendid place from which to hunt elephant. Mkula himself was a good elephant-hunter.

Sulimani's is some half-day's march from Mkula. In the winter he gets his water from a hole below his village, the Chisera being on the south side of the plain. The road from here, after running a little way along the plain, turns to the right into the bush, and comes out on the Mawe plain, a stream that in the summer flows out of the Choma on the Belgian side of the line, and runs into the swamp near the Chisera. After crossing this stream, the road leads by Chocha's village, which

is quite small, and, running along the edge of the plain, turns to the left along the edge of the Choma swamp, and, crossing the Choma by a bridge, arrives at Choma station. The march from Sulimani to Choma may be done in a day. A little over half an hour brings one to Kaputa's village, where the road leaves the woods and again enters the plains. This part is often bad in the summer, as the water does not drain off. There is a small stream that runs into the Choma some 3 miles below the station. It is about 12 miles from the station to Namkupa's, the next village. This is the general camping-place. On leaving Namkupa, the road goes up the side of the hill—a rather steep climb—and passes through some fairly good woods. The next camping-place is generally in the bush, but the water here is never good, and in the winter there is often difficulty in finding it. The next place is Chiyengi, where there is a station of the African Lakes Trading Corporation. This is on Lake Mweru. The road's general direction is west. The country consists of open plains and dense bush, called matesi; there are stretches of open woods, which look charming in the spring, when the new grass is a few inches long, and the trees have just put on their bright green leaves. There are delicious scents as one goes through them; but, unfortunately, this time does not last long. There is very little good timber, as nearly all the trees are small; but there is a clump of good timber at the south end of the swamp, near the head of the Mofwe stream, but it is of no great extent.

Though it is called the swamp, there is not much swamp about it. There is a stretch of swamp at the north end, where the Choma enters the plains, and another at the south end. It is a huge stretch of nearly level plain (with short grass along the edges), anywhere on which, on a clear day, one can see the surrounding hills. When the rains start, the grass grows fast, and reaches to a height in some places of 10 feet and over. There are large stretches covered with a growth that reaches a great height. This growth has a stem sometimes an inch thick, but generally under this, and when green is very sticky, and has a small green leaf. It dries up and becomes extremely brittle, and makes a great noise as it snaps when one passes through it. I mention this, as it is a favourite place for elephant.

The water lies about a foot deep in the summer, over a large stretch of these plains, which at the north end, near the Choma and Chisera, are much cut up by small spruits and hippo tracks. The water soon dries up, however; practically, no water finds its way from the swamp into the Kalungwisi river, on which Rhodesia station is built. The Mofwe, which at one time must have been the outlet, has next to no current now. There used to be far more water here, from what the natives say, as at one time they had to use canoes to get from the edge to the Kipiri (a small hill in the centre), which may now be done with dry feet. In August the grass dries up and is burnt off, but soon springs


Sketch Map
of
THE MWERU DISTRICT
by Mr. H. Croad
Scale of Miles
0 5 10 15 20
29°
28° 30'
30°
8° 30'
9°
9° 30'
Kidobe
R. Choma
R. Mawe
dry in Winter
Choma
B.S.A. Station
Chocha
Funkwe
Kaputa
Chikasa
Katere
Knight
Palmer
Luchina
Road to Sumbu
Sulimani
Road to Chiyengi
Kamkupa
Kipiri
R. Chisera dry in Winter
Pondera
Bare Salt Mud Plain
covered with water
in Summer
R. Mwambezi
Swamp
Open
Water
Abdallah
R. Mkubwe
Lake Mweru
Rhodesia
B.S.A. Station
Hot Springs
Kasengare
Walker & Boutall sc.

up again and gets dry; and the fires seem to go on burning below the surface, for as soon as a little wind springs up, the fires run through again, sometimes three times. The ash left is very thick, coming in some places halfway up to the knee, and it is too hot below the ash, often for a couple of days after the grass has burnt, for the natives to walk through it. South there is a large stretch of salt mud, cracked in every direction, as it has dried up. Old hippo paths are the only thing to break the monotony.

The Choma runs a good way west of the Kipiri, but one does not notice any current in the dry season below this. As the rains start and the water comes down, this stream overflows, and the water runs over the plain. This is a splendid spot for elephant. Mr. Knight and myself have seen from the Kipiri fully six hundred elephant, stretching right across the plain. The shores of the plain are sandy, and I have not the least doubt that it was once a large lake. In fact, almost up to Mkula's, one sees along the sides of the hills a line, sometimes more than one, of round wave-washed stones, showing where the old shores were; and, coming down to these, one sees the paths that hippo make when they nightly leave the water. That there must have been large lakes, and a huge rainfall, in this part of Africa is, I think, without question.

On the hill round these plains is the dense elephant bush, all tangled together and almost impassable, but for the elephant paths that cut it in all directions. The ground looks like clay, half burnt into red brick, and there is in places what looks like iron slag, often polished on the surface, as if fused into iron by lightning. This red clay seems to be the same as on the south cliffs of Kilwa island, on Lake Mweru; but on Kilwa it seems to have been better burnt, and has become like paving-stones, lying in strata, and easily detached. All this country seems to speak of great heat and upheavals of nature. This red ground is often cut into great holes by the elephant when digging for the roots of the trees that grow in this bush, and often tearing up large stones that may come in their way, with their tusks. These roots are often as thick as a man's leg.

The country is not of much use for cultivation in this part, except along the plains, where the natives get large crops. The crops along the Choma river are good, but the ground is very salt. The plains between Choma station and Namkupa's are the large salt-producing part of this country. People come for a long way south of Tanganyika, and, with the permission of Kaputa or Namkupa, build grass huts and set to work to make salt, which they take back with them. One often sees the white salt on the open spots, left by the evaporation of the water. The natives make a salt of rather dirty character, which is not much to be wondered at, considering the rough method they have for making it. They go out with baskets, and, having cut off the top grass, fill them with

the soil, and take it to where they have prepared filters. These filters are made of grass, tied thickly round a hoop, and brought to a point at the bottom; they are supported on four sticks driven into the ground, and a vessel, made of the bark of a tree, taken green and dried in shape, is placed underneath. Making a mixture of the earth and water, they pour it into the filter, and let it drop through; they then empty the salt water into pots placed over fires, and evaporate the water. This salt could be bought for four yards of calico a load, of about 40 lbs., but I believe the price has gone up.

There is plenty of game in this part—puku, hartebeeste, roan, sable, and eland. Situtunga and inyala are to be seen in the swamps, but are hard to find. There is an occasional buffalo or rhino; there are a good many of these across the line in Belgian territory. There are bush-buck, duiker, and impala in the bush country, and plenty of water-buck. There are huge herds of zebra along the Mweru swamp; klipspringer may be found on the hills north of the Mawe, and an occasional blue-buck. The elephant-hunting is, I believe, as good as any south of the Equator, but though there are any number, they must be hunted for; men must not expect to see them when on the march with a caravan, as is the case, indeed, with all the game.

There are plenty of geese and duck, and the partridge and guinea-fowl swarm. There are a lot of hyæna and leopard, and the lions are far too numerous for the good of the buck. The lion goes about in herds of twelve or more together, and has been seen in herds of this number hunting zebra on the plains. They sometimes attack men on the roads, but only, I think, when driven to it by hunger, when their teeth and strength are too poor to kill game. The Mweru swamp in November is the best place I know of for elephant; I have killed several on the plains there. But the shooting is quite open. There is, as a rule, no chance of cover, and the hunter must depend on his gun. There are swarms of hippo in the swamps, but they are hard to get at. Occasionally, when the water is falling, one finds a place where some dozen hippo have cleared a spot in the grass and taken up their quarters, and one can shoot the lot if one so wishes, as they have no chance to escape. It is rather dangerous work, as the grass one walks over is floating, and going through into the water and deep mud means a bad time, even if one is able to get out again, as sometimes a man is not able to reach the surface on account of the grass. There are large stretches of papyrus, which grows so as to completely cover the largest elephant; and there are innumerable hippo tracks, overgrown with grass, that look all right till one goes over one's head in water. The natives kill some hippo by spearing them through the grass; they can see where they are by the movement of the grass, and, running on the surface, they drive their spears into the hippo's backs.

The Choma river is grown over with grass, and is of no use for a

canoe. There are lots of fish which will take a hook in the open places; these are chiefly what the Americans call "mud-cat," but are fairly good eating. The natives catch lots when the water falls, by building fences and putting down baskets, so that the fish are caught in them as the water drops. They also catch a good many partridge and guinea-fowl in snares; and they trap a good many bush-cat for their skins. The natives, as a whole, are not good hunters or trackers. A native elephant-hunter puts all his trust in the charms that he carries, and these generally fail him.

The natives are a peaceable lot, and go in for agriculture for four months, and sit down and eat for the rest of the year. They are chiefly people who have left Congo territory. This country was raided out by the Arabs, and when the Administration came into it, the only villages to speak of were Namkupa's and Kaputa's; now there are a lot of small villages scattered about, and the country is well populated for Central Africa. Lualika, who occupies the village near where the Choma flows into the swamp, and who gets splendid crops from the rich land on which he lives, was living on the Kipiri in the swamp, and tells of how he was nearly eaten by the mosquitoes, and how hippo used to walk through his village by night, and elephant to look in on him by day. There is no hut tax; but the Administration get what men they want as porters and as workers from the chiefs, who are asked for men in their turn, in accordance with the number of men they have under them. There is now no difficulty in getting men.

When a new man comes into this district, he comes before the official, and if he has any claim to ground, as having lived there in the old days, or his people having done so, he is allowed to return to his old site; or if he is not an old inhabitant, he is put with one of the chiefs. These men are all small headmen, no single man will live by himself. Though the men do a little work themselves, and build the houses, the women do nearly all the work in the fields. The huts are of the usual round style. A circle is marked out, and posts are driven in, at the most 2 inches thick; these are bound together, and reeds bound round the tops, when the posts are cut level. The roof is made of reeds, placed leaning against the sides and meeting in the centre; these are tied together, and it is turned over and placed on the top; it is thatched with grass, and the walls mudded. The roof reaches some 3 feet from the ground, and forms a veranda, part of which is sometimes closed in, and forms an extra room. The walls are about 5 feet 6 inches high. There are generally mud seats inside, and also low ones outside under the veranda. The beds are made by placing poles on four posts driven into the ground, and reeds are tied across these. The men seldom go into their huts in the daytime, and always have a wood fire at night.

In most of the new villages there is no protecting wall round the huts. But the old villages are what are called tembes: they have two mud walls, some 6 feet apart; these are divided into rooms, and have a mud roof all the way round. They have loopholes outside and inside, so that, if the enemy should get inside, they can shoot across the square, and also one side can sweep the roof on the opposite side.

The mail service is carried on by police, of whom a certain number are kept on the station, and who are armed with sniders. They are drilled by the official, and are used for keeping order in the district. All small cases go before the chiefs, but a native can always appeal to the official. Cases between chiefs naturally come before the official, who is treated as the sultani of the country. In the case of an elephant being shot, the chief whose man has shot it sends in the tusks to the official. The Administration takes the ground tusk: this is supposed to be the tusk nearest the ground when the elephant falls, and which by native law belongs to the sultani of the country. The pay for porters is reckoned at about one yard of calico per day. Men from Sumbu or Tanganyika are paid at Choma, and new men taken on to carry the loads to Rhodesia station. Men prefer to take loads rather than to work. The pay for workers is only six yards a month. Workers who cannot go home at night get "posho," or four yards a month for food.

The women are generally without the hideous ornaments used by some of the tribes, but a few have small brass things through their lips, or through one side of the nose. They have the usual love for beads. They all wear calico, though some have not very much, and they love bright colours. There is not much tattooing.

Before going after elephant, a hunter will go through a certain ceremony, and will be painted with red and white on the chest and face. They will go great distances, to a man who is known for his good hunting charms. They have small grass huts, about a foot high, under which they place the elephant-tusks after a successful hunt. They leave them there for about three days. A successful elephant-hunter is met at his village with great rejoicing. The people are well built on the whole, though as a rule they are not tall. There are a few cases of madness amongst them. There are special men in each village who do iron and wood work; but they are poor hands at these things, on account of the rough life they led when raided out by the Arabs.

They have no cattle, and but few goats. Horses would, I think, do all right if they could be brought up. The crops consist of Indian corn, millet, casava, sweet potatoes, beans, oil seeds, pumpkins, and tobacco. There are made roads near Choma station over to Kaputa, and a branch running towards Lualika, but only going as far as Mr.

Knight's place, which is about 6 miles down the river. There are two whites in the Choma division. The rainy season begins in December with short showers, and the heavy rains are over about the end of March; the grass is burnt in July. The natives are mostly armed with cap guns, and nearly all carry spears. One seldom sees a bow and arrows.

Large tracts of land are now being put under cultivation by the natives. The edges of the swamps can be turned into rich rice-fields, and can produce a huge crop. European potatoes can be grown well too, with a little trouble. The climate, in spite of the large swamps, is not worse than in most parts of Central Africa, and with care whites can live without much discomfort.

II. EXPLORATIONS WEST OF THE LOANGWA RIVER.*

By CYRIL D. HOSTE.

In December, 1895, the late Dr. J. A. Maloney, having constructed his wet season's camp at Mafuta's, some 20 miles north of the Angoni chief Mpeseni,† returned to England. His sudden death preventing his return, I was instructed to proceed and explore the country to the west of the Loangwa river.

On August 17, 1896, having engaged enough carriers from the villages close to us, my companions and I left Chinunda and took the now well-known path to Kambwire; only stopping long enough to obtain additional carriers, we passed on to Chisiri, on the Aruangwa (Loangwa) river. This chief lent us three very small canoes, with which we transported our loads across. The path led us through a Mopani forest, and we crossed the Mpamasi river about 20 miles north of Chisiri. Game was fairly plentiful in this part, the chief antelope being, of course, the impalla; and I noticed the spoor of kudu, roan antelope, water-buck, and wart-hogs. A good troop of elephants had also moved off, quite recently, from that river. After crossing the Mpamasi, the path takes a turn to the north-west, and we reached the villages of Kavimbe and Mnawaria, on the Mnyamasi river. I sent up for the chief, and was rather surprised to find Mnawaria a woman. She has a good deal of authority over her people—in fact, more than one generally sees among the chiefs of these small Wabisa villages. To the west of her village there are some sandstone hills, at the foot of which, on the east side, there is a very strong sulphur spring of boiling water.

After leaving Mnawaria, we again crossed the Mnyamasi river and struck to the south-west, reaching the Mtinondo river, having passed over a track of country strewn with water-worn stones. The country for 10 miles before reaching this river is open, and we had a good view of the Mchinga range, which looks like a wall stretching north and south without a break, except for two very fine waterfalls, where the Mnyamasi and Mtinondo seem to drop directly from the Mchinga plateau to the low country of the Aruangwa (Loangwa) valley. As the carriers

* Map, p. 692.

† See Mr. Money's map of British Central Africa, *Geog. Journal*, vol. x. p. 236.

were running short of food, we were not able to get a close view of these falls, but had to make for the nearest village, which was Mpemba, on the Matisi river. From here we moved on to Chitala's village, on the Mpamasi river. Chitala (known to Joseph Thomson as Katra, and to Mr. E. J. Glave as Katara) belongs to the Wabisa tribe, and is, I believe, related to Kambwire, who used to live in this district until he could stand the Awemba raiding-parties no longer, when he moved eastwards, and built his village where it now stands on the Lokusye (Rukusi) river. Chitala told me that his name was Chitala, and not Katara or Katra, but he is sometimes called Chiwesa, and I have frequently heard him called by this name myself.

Soon after arriving at his village, Chitala brought me a letter written by Mr. E. J. Glave, of the *Century Magazine*, who passed through in June, 1894. This is a copy of the letter :—

"Katara's, June, 1894.

"*To any Gentleman visiting this Chief.*

"Sir,—He is the most hospitable and friendly chief I have met in this part of the world. He is, as far as I can learn, loyal to the British. He permits no Arab to enter his stockades, and allows his people to sell them no slaves. He can supply guides either across the Mchinga mountains to the Ilala country, or to Kambuidi (Kambwire?), *the* Bisa chief to the south-east from here. He is thoroughly friendly, and most anxious that the British build a fort, somewhere in the country, to protect his neighbouring villages against the Angoni of Mpeseni and Mombera. With a very little assistance from the whites, such men as Katara can hold their own against their enemies. Two hours from here will be found a curious section of country strewn throughout with sections of fossilized timber.

"Between here and the hills you can get sport—eland, koodoo, water-buck. I went out twice—each time got a beast, first eland, and then water-buck.

"Very truly,

"E. J. Glave,

"Special correspondent of the *New York Century Magazine*."

The fossilized timber mentioned by Mr. Glave is scattered over a very large area, and is to be found almost as far south as Chilenga's village. The country at the foot of the Mchinga range is very much cut up with "dongas," and here again we found a great deal of water-worn stones, chiefly a very poor quartz. The range itself is composed almost entirely of granite, and, except for where the granite is protruding, trees cover the whole sides and summit. The timber is chiefly machabel, gusi, mopani, and on the higher country mahobo-hobo; bamboos also grow at the foot of the range along the banks of the Mpamasi river. Chikwanda, the dreaded chief of the southern Awemba, lives on the high plateau, his village being two days to the north-west of Chitala.

After crossing four running streams we reached the Kapamba, which is a fair-sized river. Here we saw a troop of about fifty elephants, but were unable to get a shot. Crossing the Kapamba and Luanda, the next river of any importance is the Mtisasi, where we found the remains of an old village, which the natives say belonged to Chilovi, who was raided and burnt out by the Chikunda from the lower Aruangwa (Loangwa). All that remains of the village is a large grove of bananas. Between the Mtisasi and Chilenga's village we crossed seven streams, all of which contained good cold water.

Chilenga, Chinema, and Mtanda have their villages close together, and their mother, Anatandali, has her village about 4 miles down the Lusuaswe river, which passes through this small colony of Mlala people. These people came down some years ago from the plateau, as they found that the soil was more fertile in the low country.

From Chilenga's we moved up to the top of the mountains. The climb was very severe even for us white men, who carried nothing, but what it must have been for the carriers with their loads it is hard to imagine. They only asked that the drummer might be sent on ahead, so that he could sit on the top of the mountains and beat his drum, and they could then tell how much further they had to climb. The country at the edge of the plateau is a good deal broken up with large valleys and rocky "kopjes," and the formation is granite; but after passing through about 2 miles of rough country, we got a view of rolling bush veldt, which extended as far as we could see. The climate on the plateau is delightful, and, of course, much cooler than the Aruangwa (Loangwa) valley. While up on the Mchinga plateau this time I bagged a very fine old sable antelope bull, the first and last which I saw in Central Africa. It must have been a very good game country before the cattle plague passed over it, as game can find green grass all the year round, and water is very plentiful.

Returning to Chilenga's to meet some of our party who had brought up further supplies, we next moved to Saide's village, on the Aruangwa (Loangwa), crossing the Mtisasi river 5 miles to the east of Anatandali's village. Then we struck south through Kampara, and stopped for the first night at Chombomere, where the Lusuaswe joins the Aruangwa (Loangwa) river. From here we went south-west, passing through two or three small Chikunda villages, and reached Señor Cardoza's place at the junction of the Mpapushi and Aruangwa (Loangwa) rivers. Cardoza, or, as the natives call him, Mzassa, is a black Portuguese.

Finding that we could not get through to Salisbury, on account of the Mashona rising, I here turned back, and, sending some of the white men home *viâ* Kota Kota, Blantyre, and Chinde, proceeded with the others to Chombomere; then, striking straight across to Chilenga, climbed up to the plateau again, and built our huts for the wet season about 2 miles to the east of the Lusuaswe river. Fresh provisions and calico having arrived from Blantyre, I started off to look at the country about Serenje's village, and make, if possible, round to the south. Crossing the Lusuaswe over a natural bridge, we reached the valley of the Wangala 5 miles further north, and followed that river to its headwaters, which are close to Serenje. Serenje has moved his village since Joseph Thomson passed through, so as to be nearer a large iron-mine which supplies the whole of this country with materials to make assegai-heads, axes, hoes, etc. Striking to the north-north-east, we came to Nansara, on what Joseph Thomson calls Moir's lake, though now it is little more than a swamp, being overgrown with grass and reeds. Nansara told me that the situtunga antelope inhabits this swamp, although of course he did not know it by this name, calling it the n'zoe.

Five miles to the west of Nansara we passed Serenje's old village, on the headwaters of the Molembo river, which, the guide told me, runs into the Luapula. Mchinka's was the next village, lying about 18 miles west of Nansara. Striking to the south-west, we passed through a more open country, which is well watered, and reached Kawamba, having passed Kwamwando about 6 miles to our west. Crossing the Chipendesi, we passed through Mkwessa's and Chikolongo's, and reached Muwundu, or Kawondo, as he is sometimes called. The country changes suddenly at the crossing of the Chizimba river, between Chikolongo and Muwundu,

to a schist formation, whereas all the journey before reaching the Chizimba was through granite, with an occasional iron "bar." The whole district passed through would make a good farming country, and is well adapted to stock-raising, as there is good feed all the year round, plenty of running water, and, as far as I could see, no tsetse fly. The climate is as fine as any that I have ever seen in Africa. The water is good and plentiful. The timber is almost the same as in Mashonaland. The whole country has been covered with it, but the natives have cleared large tracts for their fields.

Muwundu has the largest village of any Mlala chief that I have yet seen, and after he got over his first scare he seemed to be a very good specimen of his tribe. Taking the path to Chaiye, we crossed the Chizimba and Mweshia, besides a few smaller streams, all running to the south through a very rough and broken country. The Mweshia is a very good river, with a tremendous current. Between the Mweshia and Chaiye the path takes one over three high ranges, passing close to Chilefwi mountain, over the top of Miniwanga mountain, and then suddenly drops down to the Kaombe river, on which Chaiye has his village. The difference in temperature on the Kaombe at this point was very noticeable, being a good many degrees hotter than the high veldt.

On inquiring about the country to the west, and where the Lokosashi had its headwaters, I found all native opinions differed, so determined to go west and see for myself. The only thing that they agreed about was that the Lokosashi rose in the Irumi mountains.

Striking west, after traversing a broken country, we reached Katiso hill, which is a bald granite kopje, after rising, according to my aneroid, about 1000 feet since leaving Karulania. Kamela and Lalusia are the next villages, both on the Lokosashi rivers. Passing by the villages of Wemba, Mkwampura, and Chimkwampi, we reached the new village of Chiwali, who seems to be an influential man amongst the Mlala, and is building a very large village. There are a good many open valleys in this district, and plenty of water, the whole country being drained by the Lokosashi and its tributaries. Going north from Chiwali, we passed the old deserted village of Kafura, on the Chimpinda river, and camped for a night at Mtinauli. The next morning we crossed the Lokosashi again running south-east at the drift. Striking east after crossing it, we next came to the Chipondesi, which we crossed by a natural bridge. This bridge is formed by one enormous boulder, under which the river burrows, coming up again 40 yards lower down. Still continuing to the east, we passed Changwi and Chintankwa, and reached Muwundu on April 28. Having rejoined our party, we struck across towards Serenje's to escape the rough broken country immediately to our east. We passed through a splendid district, crossing the Mweshia, Msuema, and Kaombe, and got into our old road near Serenje's iron-mine, reaching our main camp on May 11. On our next journey we struck north, crossing the Kapamba, and, passing through a good piece of country, got on to Joseph Thomson's road, which we followed down the mountains to Chitala. There is a much easier descent from the plateau here than at Chilenga, and the scenery is very fine all along the Mpamasi. From Chitala we took our old road back to Chilenga, and soon after reached the main camp. Our relief having now arrived, we commenced the homeward journey. Walking as far as Cardoza's place we took canoes down to Zumbo, which is close to the junction of the Aruangwa (Loangwa) and Zambesi. From Zumbo to Kachomba took us five days, at which place we had to leave the canoes and walk to Tete (eight days), taking the broad "machila" road to the south of the river. At Tete we engaged a house-boat to take us down the Zambezi, and arrived once more at Chinde, after an absence of over two years.

NOTE.—The accompanying map is made from compass bearings, and distances measured by the time of marching.

Kambwire's, near the Loangwa river, was taken as a fixed point from which to commence the surveys.

APPROXIMATE HEIGHTS ABOVE SEA-LEVEL BY ANEROID.

	Feet.
Chintankwa	4440
Chizimba	2890
Chiwali	4360
Chaiye	2190
Kamela	3490
Kaombe	5090
Karubuma	1990
Katiso	2990
Mtinauli	4340
Muwundu	4290
Mweshia river (upper crossing)	2990
Mkwampura	4340

HEIGHT BY BOILING-POINT THERMOMETER.*

Kasandwe	4795
Kwakumbi	1818
Mambesa	2173
Sunda	2062
Saide	1931
Lusuaswe river camp	1984
Mzasea	1612

ON SEA-BEACHES AND SANDBANKS.†

By VAUGHAN CORNISH, M.Sc. (Vict. Univ.), F.C.S., F.R.G.S.

§ 11. ON THE CHESIL BEACH, A LOCAL STUDY IN THE GRADING OF BEACH SHINGLE.

The Chesil Bank has long been a sort of prize puzzle among beaches, and space forbids detailed reference in this place to the somewhat extensive series of papers which geologists and engineers have written upon the subject. To put the matter shortly, the chief *crux* has been the circumstance that the pebbles are fine at the west end and coarse at the east end. This has been generally regarded as a peculiarity to be explained by special causes, as, *e.g.*—

(*a*) That the material travels from east to west, and not from west to east,

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* Kindly communicated by Dr. J. S. Hyland.

† Paper read at the Royal Geographical Society, March 16, 1898. Continued from p. 543.

which is to make the material travel for the greater part of its course against the wind and waves and stronger tide current.*

(*b*) That the material travels from west to east, but that the sea transports the larger stones more quickly than the small.†

This seems to be a mistaken deduction from the circumstance that large pebbles can outstrip smaller ones when rolling freely down a slope, a case which has little analogy with the transport of pebbles along the shore, where buoyancy is the important factor.

(*c*) That the arrangement of the shingle on the Chesil Beach is due in but small part to what is happening now and has happened of recent years, being mainly due to circumstances operating through long preceding periods.

Now, the stones supplied in bygone ages were either friable or they were not.

FIG. 3.—EAST END OF CHESIL BEACH.

If friable, they no longer remain on the surface of the beach; if not friable, then such as still remain on the surface of the beach have made countless journeys to and fro in the course of countless tides and waves. The Chesil Beach is periodically raked over by the sea throughout its whole length and breadth. Thus the present arrangement of the stones upon the surface of the beach is certainly conformable with the present circumstances of wind, wave, and tide, whatever may have been the original mode of supply of the shingle.

The Chesil Beach, in the greatest extension ascribed to it, is reckoned to reach from Bridport harbour to Chesilton In my study of the grading of shingle on this beach, after two preliminary visits to the Chesilton end, I started from Bridport harbour, and made my way on foot from thence to Abbotsbury (first day), taking samples of shingle, and thence on foot and by boat to Chesilton (second day). On

* For particulars of the tides, see King's 'Channel Pilot,' 12th edit.

† Sir John Coode, *Min. Proc. Inst. C.E.*, vol. xii., 1852-3.

the third day I went by boat close under the shore to Blacknor Point, landing occasionally, and then walked back from Chesilton for about a mile westward along the beach. Near the west end of the beach the material of the cliffs is mostly fine, and hence in travelling will be graded up, *i.e.* the *average* size will increase (Law 2). It is, however, obvious, upon slight inspection, that the small shingle of the beach, from Bridport harbour to Burton Bradstock, is not mainly derived from those cliffs, and hence the grading of their detritus is not the principal, and probably is but a small factor of the whole process of grading up of the shingle during west-to-east travel. I found that the increase in size of shingle was very gradual until near the Chesilton end when the increase became rapid, at the same time that a certain kind of flattened white stone became conspicuous. On arriving at "the end of the beach," that is to say, where the foreshore is almost entirely composed

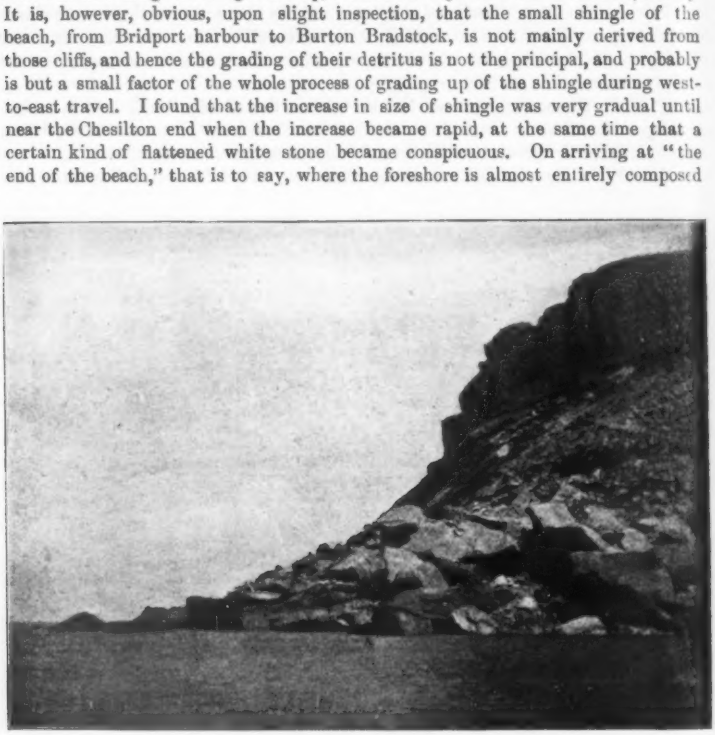


FIG. 4.—BLACKNOR POINT, PORTLAND.

of material freshly supplied from the Portland cliffs, it was evident that these white stones were from the Portland rock, which is here fed to the foreshore by tipping the waste stone of the quarries, which have for many years been extensively worked on the plateau (Figs. 3 and 4). Almost all the fragments thus supplied to the foreshore are large, for not only is the stone compact, but, as is easily recognized, the material is sorted by sizes in the well-known way by tipping, the fine stuff mostly remaining near the top, and the large fragments mostly reaching the bottom. Nevertheless, the material within reach of the breakers, though mostly large, contains a notable quantity of little stones, not, however, rounded shingle, like the small stones near Burton Bradstock, but for the most part angular, which indicates that they have been produced on or near the spot by chipping and breaking of larger stones. Under water I saw, from the boat, a great store of rounded boulders, larger than those upon the beach. On retracing my steps westwards along the beach, I lost sight of the chips almost immediately. My attention

was given to the flattened white stones, which I found to decrease rapidly in average size within the first mile of their origin (Law 1). We see, then, that the grinding down and bodily removal of fine stuff from the fresh detritus, copiously supplied by the Isle of Portland, is an important factor in the grading of the beach in its eastern part. The sudden change in the direction of the coast-line at Chesilton is sufficient to account for the supply to the beach of a very large proportion of the big fragments from the quarries and cliffs (for the south-westerly winds must send the waves along the shores of Portland in towards Chesilton). On the other hand, the strong *outset* along this shore (see *post*, Fig. 11) is sufficient to explain a rapid removal of the *chips*.

The wind during my visit being easterly, I saw, especially in the neighbourhood of Abbotsbury, how the gentle waves from the east, which must transport shingle in a westerly direction, were picking out all the smaller stones, so as to leave the part of the beach which they raked over much coarser than the beach immediately beyond their reach. This illustrates how the operation of Law 5 assists to increase the proportion of fine to large shingle at the west end. But on reflection, while the proportions of the things seen were still present in the mind's eye, it seemed to me that something was still lacking to explain the greatness of the accumulation of fine, rounded (and therefore travelled) shingle at the west end, an accumulation the more remarkable that large quantities are annually shipped away at Bridport harbour, and that the shingle there is mostly fine throughout its whole thickness. I therefore took an early opportunity of examining the shore to the westward of Bridport, which, strictly speaking, I ought to have done before, for no beach not supplied by waste of the shore at back of it can be adequately studied within its own limits; we ought always to go beyond and examine its sources of supply from both ends. I started from Lyme Regis and went to Bridport by boat and by walking, taking samples of the shingle, and then worked my way back to Lyme; and here I may note that it is advisable to walk a beach both ways when studying the grading of material. The trend of the coast changes at Charmouth, just eastwards of which the great accumulation of shingle which characterizes the eastern part of Lyme Bay really begins (Fig. 5). On the lonely shore between Charmouth and Eype, *Golden Cap and Thorncombe project somewhat from the line of coast, and a reef of rocks projects from each headland, forming altogether very considerable natural groynes, the last before Portland.* On the western side of Golden Cap is a considerable shingle beach, which rises to a notable height above ordinary tide-level, and is composed, near the promontory, of coarse shingle (Fig. 6). On the east side of the promontory the level of the beach is lower. I commenced taking specimens about the middle of the bay opposite Chidcock (or Seatown) Mouth, and found a steady increase of size eastwards, accompanied by an increase in the height of the beach until the Thorncombe or Down Cliffs double promontory was reached, where the shingle was about as big as that at Chesilton. From this point the beach to Golden Cap presents to the eye an imposing accumulation of shingle. On the east side of the promontory of Thorncombe there is no proper beach accumulation, the sea reaching the cliffs at high tide; but a beach begins to form about opposite Eype Mouth, the material being the finest shingle (Fig. 7). On the east side of Bridport harbour the size of the shingle is already *slightly* greater, and thence eastwards, as we have seen, the increase of size proceeds slowly until we near Portland, when it becomes rapid. It is noteworthy that on the west side of Bridport harbour the shingle under the training wall or pier is bigger, not only than that on the east side, but than that at Abbotsbury. Westwards of Lyme, again, there is no lack of large shingle in favourable situations, as, *e.g.*, at Seaton and at Beer.

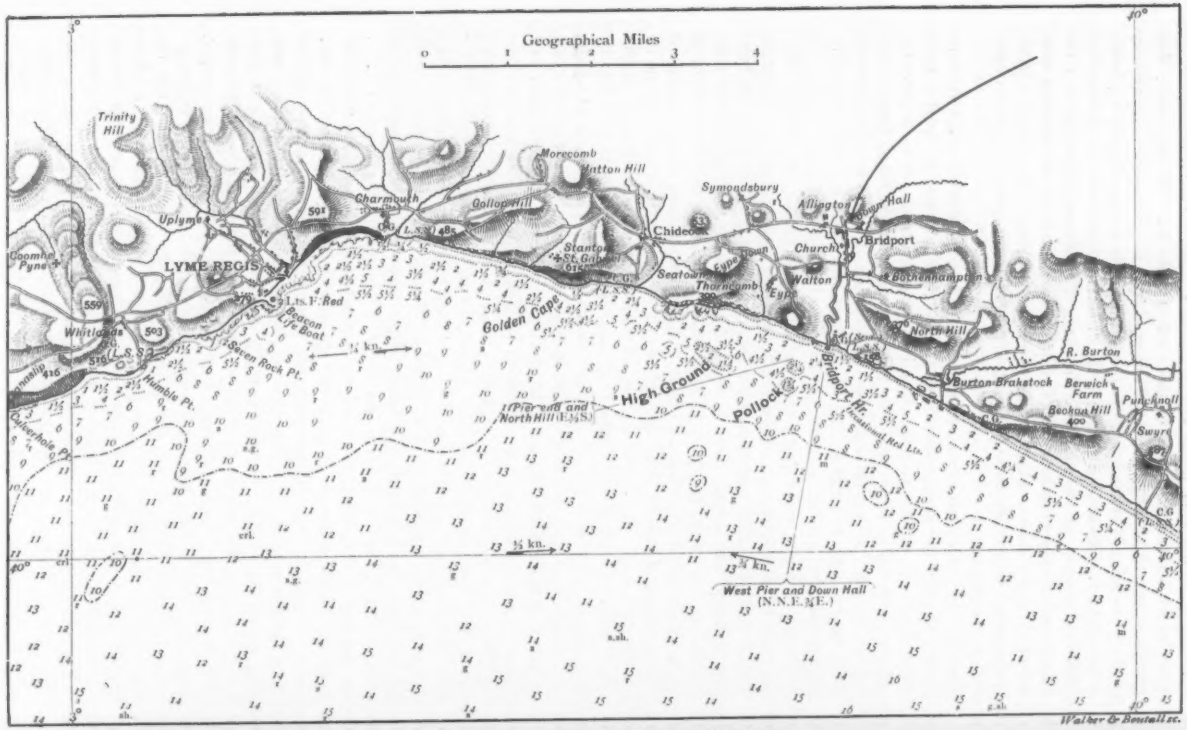


FIG. 5.—CHART: LYME TO BURTON BRADSTOCK.

FIG. 5.—CHART: LYME TO BURTON BRADSTOCK.

FIG. 6.—SHINGLE BANK, WEST SIDE OF GOLDEN CAP.
(From a photograph by F. W. Shephard, Lyme Regis.)

It appears, therefore, that, in addition to the causes already adduced as contributing to produce the observed grading of the Chesil Beach, the natural groynes at Golden Cap and Thorncombe are of capital importance, for it is these projections, to a far greater extent than the character of the local rock, which determine the supply from the west of an overwhelming proportion of fine material to the western end of the Chesil Beach (see Law 5).

There may be other factors, in addition to those of which I have taken account, contributing to produce the grading of shingle upon the Chesil beach; indeed, it is never permissible to assert that all the factors have been ascertained which contribute to produce any natural phenomenon. But I think the causes I have adduced are adequate to explain the moderate store of facts which we as yet possess as to the sizes of shingle upon different parts of this beach. To recapitulate, the salient points as to grading on the Chesil Beach are briefly as follows:—

1. The beach is fed at both ends (Bridport and Chesilton).

2. The material fed in at the west end is mostly fine, owing chiefly to the natural groynes at Golden Cap and Thorncombe.

3. The material fed in at the east end is mostly coarse, owing to the nature of the local rock and the mode in which it is supplied to the foreshore.

4. The main drift of water is easterly, but

5. Of the fine shingle carried eastward from Bridport, much is brought back by waves from the east; whereas

6. The strong outset at Chesilton removes such fine stuff as may be there supplied from Portland.

7. The largest waves converge on Chesilton from both sides.

It will be noticed that there is nothing abnormal in all this, but that the co-operation of causes is remarkable.

§ 12. The Influence of Specific Gravity on the Behaviour of Beach Material.

(*a*) Dense Minerals.—The angle of slope of the ridge of a shingle beach depends primarily on the materials of which it is chiefly composed, on their size, shape, and specific gravity. *Regimen* is attained when the assistance which gravity gives to transport with the back-wash makes the seaward equal to the shoreward transport. An individual pebble of equal size to those of which the beach is mainly composed, but of twice the specific gravity, if brought on to the *regimen* slope of such a beach will work its way down to the bottom, for its extra resistance to the back-wash is mainly that of greater inertia, whilst it resists the onwash by diminished buoyancy also. Thus it happens that dense minerals are not commonly found upon the *Fulls* of a shingle beach; but, as size diminishes, difference of specific gravity makes less and less difference in buoyancy, hence the dense minerals are ordinary constituents of sandy beaches.

(*b*) Flotsam and Jetsam.—Bodies which have so low a specific gravity that they float in less than their own depth of water are flung in upon the shore by the breaker, riding in on the back of the wave, as boats are beached in a rough sea. As soon as the depth of the water is too small to float them, they are stranded, and this is the perfection of the action by which shingle *Fulls* are formed. These objects are pushed up by each succeeding onwash, in the same way that a boat is hauled up, viz. by partial flotation on the arrival of deeper water. They thus reach the extreme margin of the wash, where they form the wrack which marks the limit of the sea's advance. The wrack is sometimes collected together out at sea. Thus, in Poole bay, when a calm or a light off-shore wind follows rough weather, one occasionally observes that the flotsam which has been drifting widely scattered on

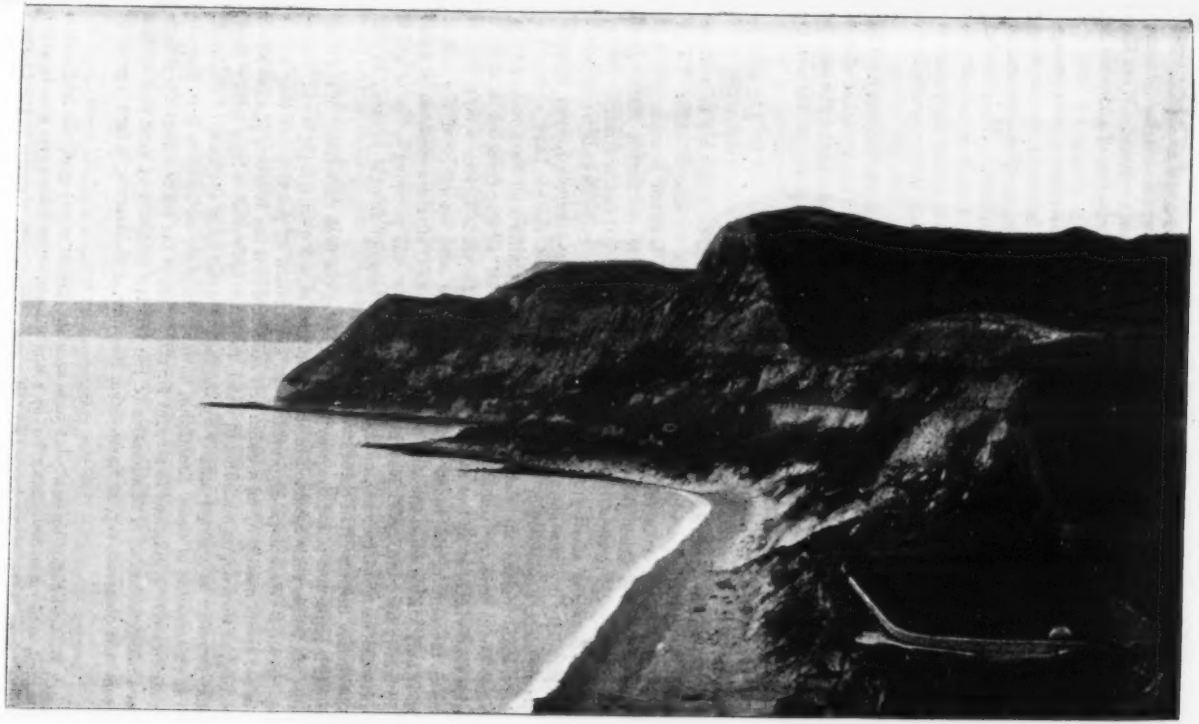


FIG. 7.— THORNCOMBE, FROM EYPE MOUTH.

the fresher waters of the ebbing tide, is caught and collected where the burrowing salt water wedge of the incoming tide rolls up the lighter bay-water as a scroll. The welling up of the water is indicated by a smooth streak,* which stretches for some miles, in appearance a meandering stream, and here the wrack collects. When the water of the incoming tide reaches the shore, the strange collection of oddments is cast upon the beach.

A body drifting in water is set so as to offer the greatest resistance to its passage through the water. Thus, a disc borne by the swirling motion of the incoming wash has its broad face downwards, resisting the upward swirls. This resistance to motion *through* the water gives the disc its greatest buoyancy. When hurried back in the shallow stream of the back-wash, the disc tends to set so as to resist the stream—that is to say, edge downwards. Thus, at the same time that the water has become shallower, the depth required to immerse the disc has become greater. In this way flat shells are stranded on the beach.

The sea's power of transport of detritus depends mainly upon buoyancy. The range of specific gravity of detritus is small compared with the variation of the size of the particles which the sea moves. Therefore the buoyancy of the earthy materials which the sea has to deal with, and hence the power of the sea to transport them, depends mainly on comminution.

§ 13. Sandy Beaches.

(*a*) The Sub-stratum of Shingle.—Sandy beaches are found not only where shingle is wanting, but where the *proportion* of shingle to sand is small. To fix our ideas, we will take the case of the sandy beach between Bournemouth and Poole Haven, on either side of Branksome Chine. The sea here is shallow, and the sea-floor is covered with sand. The cliffs, of about 100 feet, are mainly sandy, with a relatively small proportion of stones. These cliffs (which waste somewhat rapidly by weathering and drainage) must have supplied, even in quite recent times, a quantity of stones sufficient to form a shingle bank, and as the sea seldom reaches the cliff-foot, and there is no platform of hard rock, such a beach would be fairly permanent. Instead, however, of being collected in a bank with sand visible at its foot at low tide, the shingle tends to form a layer underneath the sand of the beach and underneath the sand seawards of the beach. It is only visible when the sand is removed either (1) after a succession of gales, (2) locally by a brook, (3) just behind the breaker, the pumping action of which sorts the material by sizes, increasing the *proportion* of shingle to sand, so that the surface there is often quite stony.

It is important to explain why the shingle derived from the wasting of the cliffs does not follow their recession in such a manner as to form a shingle bank. Something can be done towards providing an explanation by pointing out that stones do not travel readily up on a bed of soft sand, and that the breakers of a flat shore, falling, as they do, on a cushion of water, cannot readily *push* shingle before them, and therefore have to act mainly by the rush of water from the back of the wave. The examination of these disabilities, however, only serves to show that they are quantitatively insufficient to account for the failure of the sea to collect the shingle in a marginal bank. The alteration of the relative positions of sand and shingle from that observed, say, at Eastbourne, Hastings, or Folkestone, is far too great to

* With a light on-shore wind, I have seen the line of meeting of the tidal waters marked, not by a smooth streak, but by a line of foam, where little waves were *breaking*. In this case there are probably two salt-water wedges, with a wedge of the brackish water interposed.

be accounted for by differences in the relative mobility of the individual pebble and the individual sand-grain. *The attempt to deduce the behaviour of a heterogeneous aggregate from the observed behaviour of individuals representative of the constituents is foredoomed to failure, unless allowance be made for the proportion in which they are respectively present*, and much that has been written upon beaches is vitiated by neglect of this rule. Observations of the behaviour of shingle where present in excess lead to erroneous conclusions if applied without correction to the behaviour of disseminated shingle. We must, therefore, once more have recourse to the statistical method. At the foot of our sandy beach we find pebbles exposed under the breaker; why are these not driven up the slope of the beach to the limit of the wash? Because, *when the intensity of action begins to diminish, the pebble is soon buried by the relatively great quantity of sand which is dropped there, and is thus removed from the sphere of action*; for in beaches, as in dunes, it is only the top layer which moves. Thus the shingle which underlies a sandy beach is practically stationary, not for want of mobility, but for lack of opportunity for movement. The sand of the beach comes in and goes out according to the weather* and the seasons, the beach being thickest in summer and thinnest in winter, and occasionally almost stripped of sand after a succession of gales. When the sand is carried out, the shingle is for the most part left behind, necessarily at a low level. The incoming sand buries it, and so prevents the wash from pushing it to a higher level. Thus each round of the seasons tends to leave the fresh supplies of shingle as a bottom layer close to the eroded sea-bed. Thus, if the finer material be present in excess, it smothers the shingle and forms the surface. If the shingle be present in excess, so that pebble beds on pebble, the fine stuff is floated away from the steeply-sloping surface. In either case the material present in great excess normally forms a bank, beneath which the material which is present in small quantity tends to spread out as a layer.

(*b*) The "Low" and "Ball" of a Sandy Shore.—The formation of a beach-ridge, or *Full* of sand, is well seen when the sand is being brought in during off-shore winds. Sand being readily raised by upward-swirling water (which is equivalent to suction dredging), *the building up of a Full of sand in front of the breaker is accompanied by the excavation of a trough, or Low, at the back of the breaker* (Fig. 8). This is roughly similar to the simultaneous excavation and elevation which produces the ridge and furrow so well known as "ripple-mark." Fine dust or mud settles too slowly, coarse shingle too quickly, to lend themselves readily to this mode of distribution by waves. A *Low* is dredged out in sand when the breaker-line remains stationary for a time, as, *e.g.*, during tidal high water. During the ebb of spring tides, a lagoon is often left between the beach and a second stretch of sand. This lagoon marks the strip where the breakers act during the period of neap tides. At low water of spring tides, the belt of sand beyond the *Low* is a sort of beach, the seaward face of which is where the wash of the waves acts. When the tide is up and the sea is rough, there is an outer line of breakers on this bank, which is called the *Ball*.

(*c*) Ridge and Furrow Structure on a Sandy Beach.—A continuous *Full* is formed by on-shore action with gentle waves, but as the size of the breakers

* In a rough sea, the removal of coarse sand and fine shingle is presumably facilitated by the inertia effect already referred to. The shoreward movement of the wave is so short and sudden that the small stony particles lag behind the water. The seaward swing of the water, on the other hand, lasts long enough to impart its motion to them.

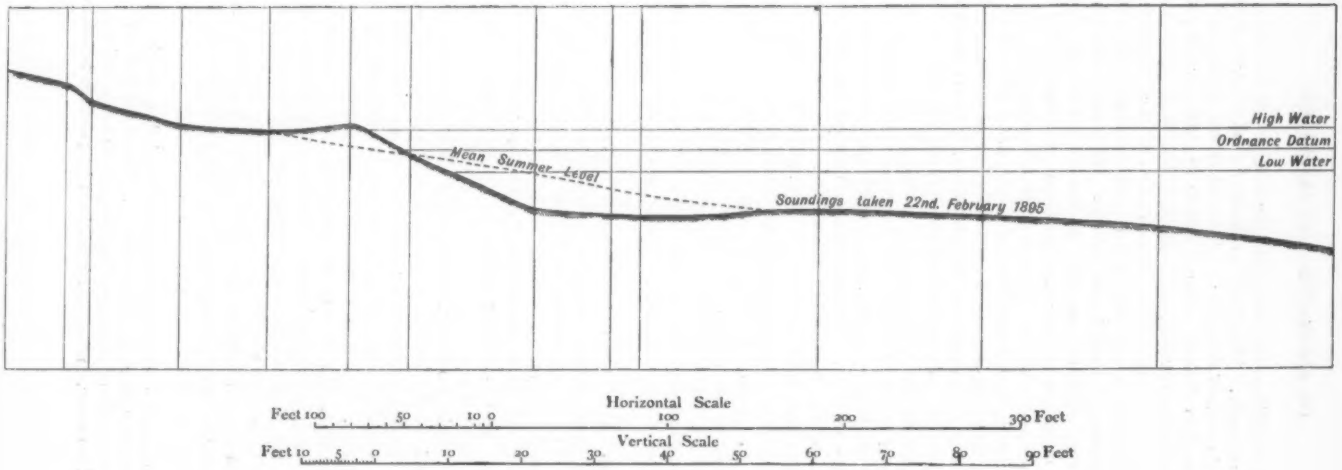

High Water
Ordnance Datum
Low Water
Mean Summer Level
Soundings taken 22nd. February 1895
Horizontal Scale
Feet 100 50 10 0 100 200 300 Feet
Vertical Scale
Feet 10 5 0 10 20 30 40 50 60 70 80 90 Feet

FIG. 8.—SECTION OF SHORE AT ALUM CHINE, BOURNEMOUTH.

increases the wash tends to make the slope less steep. Neither the force nor the resistance are absolutely uniform along the shore, so that this action commences at selected places. From the moment that even the shallowest groove is thus formed, the back-wash finds its way to sea almost entirely by this path. The discharge of the breaker continues, however, to send the on-wash up the ridges as well as up the furrows. Sand, therefore, is still deposited on the ridges, which may continue to increase in height while the absolute level of the troughs may be lowered, and the amplitude from the crest of the ridge to the bottom of the trough necessarily increases. In this way is produced that succession of ridge and furrow *at right angles to the sea-front* which is doubtless familiar to many, from the inconvenience it causes to the pedestrian.

Shingle Barchanes.—A similar structure is often produced when the waves of the receding tide have to deal with a line of shingle uncovered beneath the breaker during the time of high water. The shingle collects in ridges with

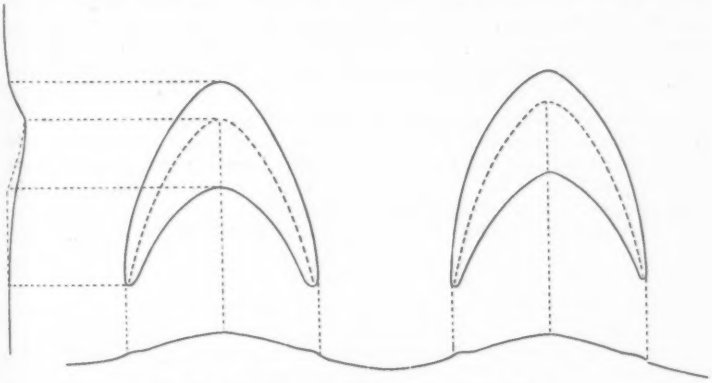


FIG. 9.—SHINGLE *BARCHANES* ON A SANDY BEACH.

intervening troughs of sand, the shingle being only swept out by the back-wash where the water is concentrated in troughs. Fig. 9 shows the form and arrangement of these accumulations of shingle, which may be termed *shingle barchanes* from their shape. Their analogy with the dune called a barchane is obvious, and this renders superfluous any detailed account of how the shape is produced.*

The carving of a sandy beach into ridges and furrows, the axes of which are parallel to the line of action of the wash, alters the character of the *Low*. The sand drawn out down the troughs forms here and there bars across the *Low*, which at low water spring tide is seen cut up into a number of oblong or oval lagoons.

(*d*) THE FLOODING OF A FLAT SANDY COAST.—Although the wash can pile up sand in a *Full* owing to percolation, this action does not afford the same protection against flooding by the sea as does the filling of shingle. This is not merely due to the greater liability of sand to be swept off-shore, but also to the circumstance that the height reached by the wash is much less when it runs a long course on the nearly flat shore of sand. On such a shore it is easy to observe that the edge of the wash is more and more below the level of the crest of the breaker in proportion

* "Formation of Sand-dunes" (*Geographical Journal*, March, 1897).

as the breakers increase in size. Protection from flooding on a flat sandy shore is given by the blowing of sand into dunes.

§ 14. On the making of Sandbanks and Sandy Forelands.

(*a*) Tidal Nodes.—In tidal seas the *rate of change* of currents is great, which brings out the inertia effects which sand shows so much better than do mud and shingle.

When a body which is capable of transmitting a disturbance, as a pulse, is disturbed at any part, a pulse is transmitted to the boundaries of the body, whence it resurges. The pulsation continues for a time, but ultimately dies out. If the disturbance be repeated at a short interval of time the second pulsation encounters the resurging of the first, and if this repetition of disturbance be kept up at regular intervals, the body presently attains a condition of persistent rhythmical vibration, being parcelled out into vibrating segments, whose boundaries are nodes. The forms of the segments are various, according to the mode of agitation of the body and to the contour of the boundary. The shallow tidal seas are thus parcelled out in vibrating segments bounded by nodes. The following remarks are intended to apply to such areas. Confining our attention to the tidal agitation of the sea, we perceive that no particle of sea-water will wander, but that it will vibrate about a position of equilibrium. The extremities of its excursions are also the extremities of the excursions of particles in the neighbouring vibrating segments. A line drawn through the points of meeting is a node. *The lines of demarcation between vibrating segments are probable positions for the accumulation of sand.** In the vicinity of a nearly straight coast-line the vibrating segments are, I suppose, elongated ellipses, and accumulations may take place along the nodal lines AA′ and BB′ (Fig. 10). If the

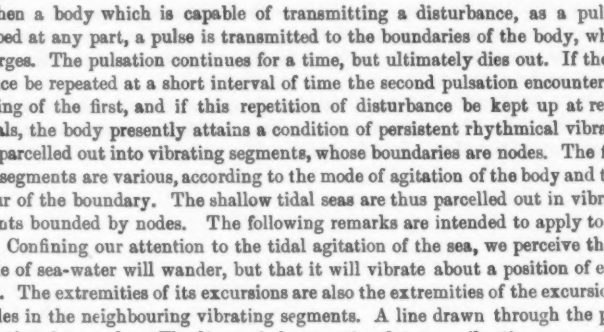


FIG. 10.—TIDAL NODES.

position of the nodes remained absolutely fixed, the greatest accumulation would take place along the A lines (at right angles to the shore), towards which there is the greatest amount of motion. But with the variations of the tides the nodes oscillate about a mean position; if, therefore, the motion in the vibrating segments be violent, there is at intervals violent tidal agitation at the mean position of the A nodes, and, unless the supply of sand be very great, accumulation does not take place there.

The displacements of the B nodes, on the other hand, are less violent, and it is therefore along these lines that the principal accumulations take place when accumulation is prevented at the A nodes. Thus I conclude are formed—

(*b*) Longitudinal Sandbanks.—Such are the sandbanks parallel to the shore which are numerous off the coasts from Flamboro' Head to the South Foreland, and from Calais, at least, as far as the Zuyder Zee. These sandbanks are parallel to the main run of the along-shore tidal currents. They present analogies with the longitudinal dunes of deserts. When the formation of such shoals is once

* Compare Faraday on "Acoustic Figures" (*Phil. Trans.*, 1831).

started, the mechanism which produced them is thereby assisted, for the currents are deflected by the ridges and concentrated in the intervening furrows. Any sand deposited at slack water in the furrows is thus swept out, say by the flood-tide, and carried as far as the end of the ridge. Here are formed two eddies of water close to one another. The sand, being denser than the water, eddies in wider curves, and the sand brought by one eddy is thus flung into the other, whose motion is equal and opposite. Thus the sand is concentrated along the prolongation of the axis of the shoal near the inner margin of the two eddies. The same kind of action lengthens the shoal at the other end during the ebbing tide. Such shoals, when small, are liable to shift with those irregularities of the vibratory motions of the sea which result from seasonal and casual variations of weather. The larger shoals are not subject to much movement from short-lived disturbances, even if violent, for these large heaps of incoherent material cannot be moved bodily, but only by the rolling of the surface layers. On the other hand, a very small disturbance of conditions, if long continued, can shift the largest shoal. Such a disturbance is the recession of the coast-line. It is probable, *e.g.*, that the shoals off the coasts of our eastern counties tend to travel at the same rate as the coast is cut back.

(*c*) The Vertical Section of Sandbanks.—Sandbanks frequently rise steeply, their material standing at the maximum resting angle. These steep sides are more common than in the case of dunes, for winds of maximum force are comparatively rare, and dunes are usually seen with the shapes imparted by gentler winds. In the case of tides, on the other hand, slack water, during which a large proportion of the deposition must take place, lasts a comparatively short time, and the shoal is shaped by the scouring currents which succeed.

There is another action besides scouring which gives steep sides to sandbanks, especially those which rise from fairly deep water. The action of the waves being in such cases great at the surface of the shoal and small at the base, sand is continually shaken over the edges, and, falling into nearly still water, gives the well-known steep *talus*. The rapid ratio in which the intensity of wave-action increases with approach to the surface thus tends to preserve a flat top to shoals. The hills and hollows of the surface of such a shoal as the Dogger bank are much less marked than is common in the case of a tract of dunes in deserts of deep sand, for the force of wind increases in a relatively small ratio with increase of elevation.

(*d*) Banner Sandbanks.—The sandbanks which accumulate on the more sheltered side of headlands, good examples of which are the Skerries shoal, eastward of Start Point, and the Shambles shoal, eastward of Portland Bill, suggest by their shape and position that they are deposited in "the eddy" caused by the headland (Fig. 11). This mode of statement, though perhaps not altogether incorrect, is apt to mislead. Thus, when the tide is running up-channel, there is an eddy known to the navigators of small vessels on the east side of Portland. Not only is the area of the obvious eddy very small compared with the area of the Shambles shoal, but its centre is not even situated within that area, but quite close under the Bill. As a matter of fact, *the materials (broken shells, etc.) which form the Shambles sandbank are not deposited in still water*, as is clearly brought out in the following note printed upon the Admiralty Chart 2450 (Portland to Owers). "From about 11.^{hrs} to XI.^{hrs} F. and C. there is an outset from the west bay of Portland of nearly 9 hours' duration, which closely skirts the rocky shore, and gradually increases in strength as it approaches the Bill. It rushes past the Bill and over the Portland Ledge at the rate of 6 or 7 knots at springs. A short distance eastwards of the Ledge this outset is met in the latter half of its course *at nearly right angles* by the stream which sets for

nearly 9½ hours (viz. from VI.^{hrs} 20^{m} to III.^{hrs} 50^{m} F. and C.) out of the east bay of Portland; these united streams press on towards the Shambles, which they cross obliquely about E. by N. at the rate of from 3 to 4 knots. The tidal streams set over the Shambles in an easterly, northerly, and westerly direction, making to the eastward at III.^{hrs} 45^{m}, and to the westward at X.^{hrs} 45^{m}, and attaining a rate of 3 to 4 knots." Thus *the sand deposits from the mixing waters of the meeting streams*, an effect that is not surprising when we consider that the mixing of waters is achieved by vortices.

The surface layers of this shoal are frequently in active motion even in calm weather,* and the permanence of the shoal under these conditions has excited surprise. In point of fact, *the permanence of a sandbank is ensured by equality of supply and loss*, the equilibrium being dynamic. As in the case of a banner cloud or a standing

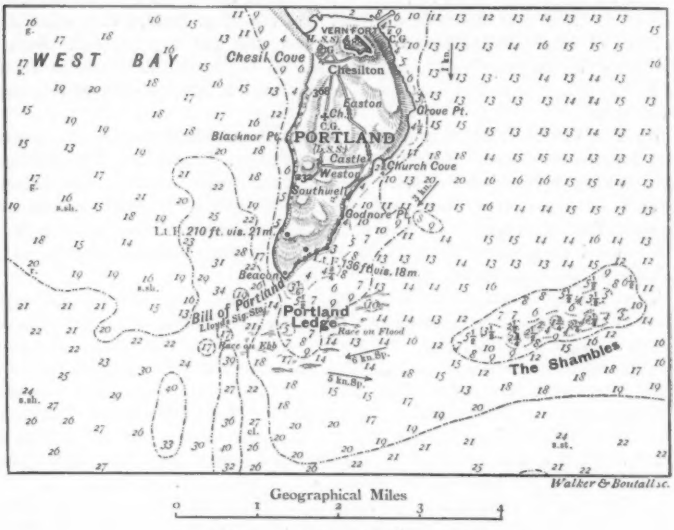


FIG. 11.—CHART: THE SHAMBLES SHOAL.

wave, the structure persists, whilst the material is changed. In the case we are considering, the supply may be reckoned as constant; the loss depends upon the amount of surface. Consequently, if a part of the shoal were removed by artificial means, supply would be greater than loss, and presumably the shoal would grow again to its maximum dimensions. Only the surface particles of a sandbank or sand-hill are removed by currents, so that the material of the interior of a stationary sandbank is unchanged. In the case of a travelling accumulation of sand, such as the moving sand-dunes of the desert, each part in succession is brought to the surface, and the materials may be completely changed.

The position of the Shambles shoal may be considered to be fixed relatively to the Bill of Portland. As the Bill is cut back, so will the shoal shift. When the coast of Portland corresponded with the position of, say, the present 5-fathom line,

* Deane, in *Min. Proc. Inst. C.E.*, vol. xi. p. 217.

the centre of the Shambles was presumably a little south and east of its present position.

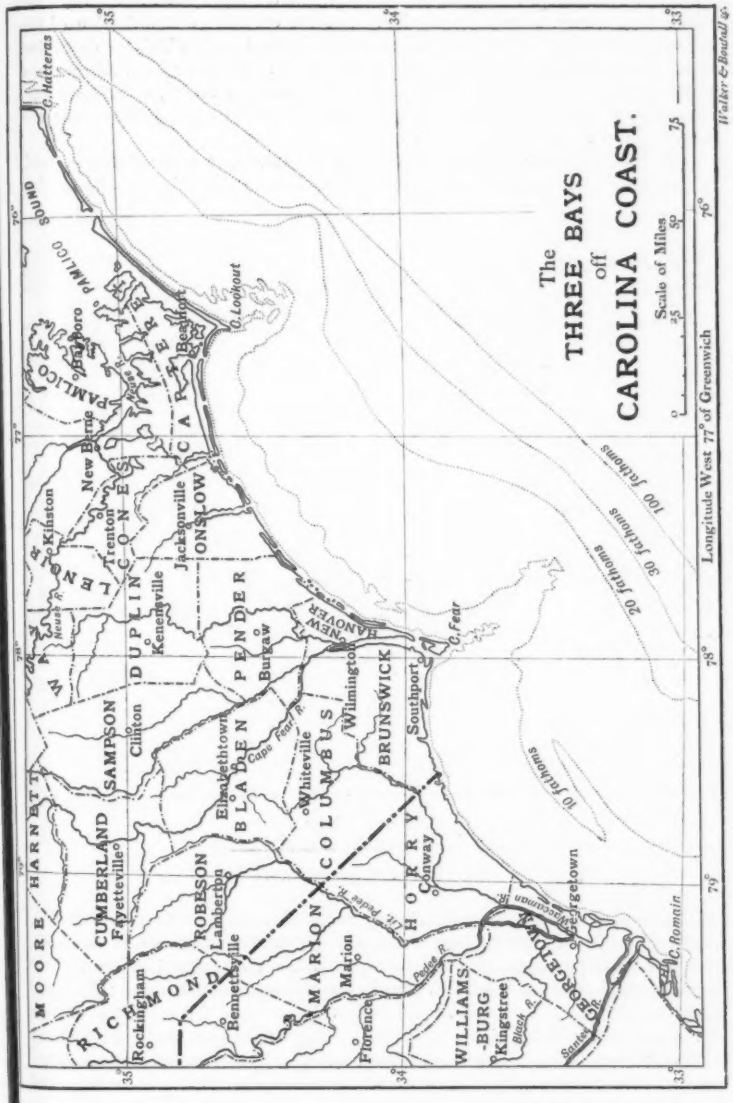


FIG. 12.—CAPES HATTERAS, LOOKOUT, AND FEAR.

(*e*) River Bars.—The entry of the salt-water wedge (see § 2) is probably an important factor in the formation of the sandy bar which usually occurs near the

mouth of a river. The inertia of the sand and its superior density must cause it to cut through the stream-lines of the river-water when this is deflected upwards,* so that the sand passes into the salt-water wedge more rapidly and completely than would be achieved merely by settling. But the checking and deflection of the streams is probably not nearly the whole of the mechanism by which the deposition of sand is brought about where a river meets the sea. A great part of this effect is probably due to the motions which attend the mixing of waters, a process which appears to be almost as potent a factor in the formation of sandbanks as is the mixing of airs in the production of clouds.

(*f*) Sandy Forelands and Transverse Shoals.—The accumulation of sand in transverse bars (*i.e.* along what we have termed the A nodes) is the action which

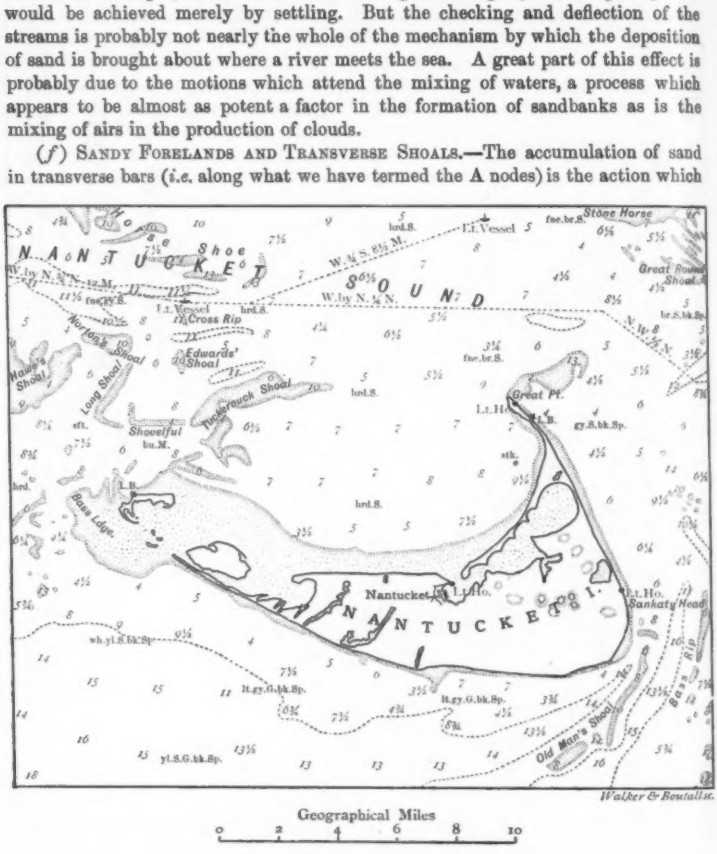


FIG. 13.—NANTUCKET ISLAND.

on a small scale is termed "rippling." It promotes the formation of sandy forelands, for the formation of such a ridge is most readily started with the beach as a base. This fact is to be connected with the circumstance that water is thrown off in eddying masses from the bank of a stream, and the same action must take place when the tide runs along a coast. Evidently this increases the amount of deposit at the coastal extremity of the nodal line. The well-known sandy forelands of North Carolina (Capes Hatteras, Lookout, and Fear) are each continued under-water as spits of sand projecting seawards for miles (Fig. 12). The under-water

* See Humphreys and Abbott, 'Report upon the Physics and Hydraulics of the Mississipi River.'

part of these great sand-ridges is moulded in accordance with the tides and currents of this part of the sea, whereas the contour-line which is "the shape of the foreland," is moulded by the action of the breakers and their wash, which, for this open coast, is equivalent to the local action of the wind, which is stated to be most powerful from the north and east.* In many cases the shape of a sandy foreland, that is to say, the form of the sea-level contour-line, conveys an utterly false idea as to the shape of the sand-hill whose top is the foreland. Fig. 13 shows how the coast-line of the northern spit of Nantucket Island curves away from the weather side, while the submerged part points seaward, presumably under the influence of a current which is stated (Captain Davies, quoted by J. D. Dana, *Man. Geol.*, p. 681 of 3rd edit.) to set from west to east and from south to north. It appears, therefore, that, if the sand which accumulates off the coast of

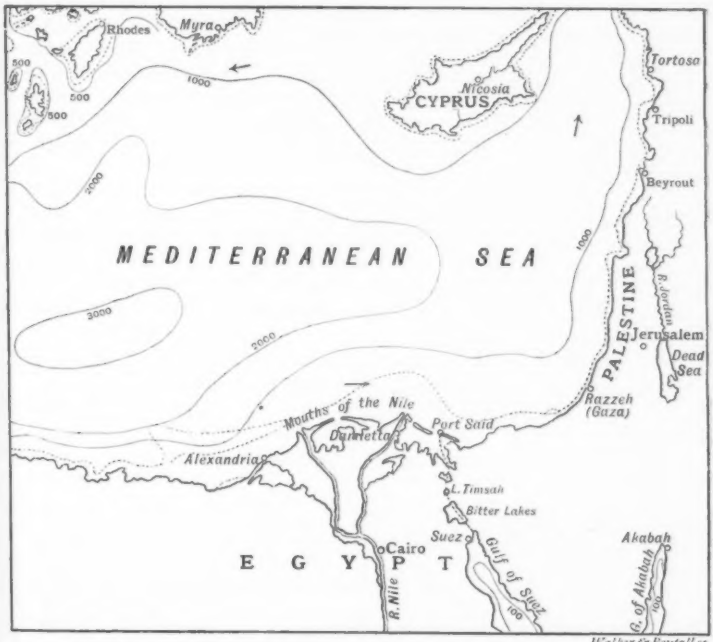


FIG. 14.—DELTA AND SUBMARINE DELTA OF THE NILE (AFTER DELESSE).

North Carolina were really moulded to the curves of contiguous "back-set" eddies induced by the Gulf Stream,† the result of such moulding should be sought, not in the contour of the forelands, where Dr. Gulliver seeks it, but in that of the submerged spits. These spits, however, do not show the required sharp points and

* See Wheeler in *Min. Proc. Inst. C.E.*, vol. cxxv., 1895–96, pt. iii. p. 17, quoting L. N. Haupt; and N. S. Shaler, 'U.S. Geol. Survey, Thirteenth An. Report,' 1891–92, pt. ii. "Geology" (on "The Geological History of Harbours"), p. 128.

† See F. P. Gulliver on "Cuspate Forelands" (*Bull Geol. Soc. of America*, vol. 7, pp. 399–422).

double-concave curves. In the same way, the east-flowing current off the south coast of the Mediterranean is recorded in the form of the submarine parts of the Nile delta (Fig. 14).

A stream which erodes an alluvial channel continually increases its sinuosity (until a "cut-off" takes place), because the opposite banks or shores are close, and the current is relatively rapid. Thus the chief scour is directed into the bays, and deposition on the headlands of the material thus removed is promoted.* Such co-operation does not occur between opposing coasts of the sea, so that the scour is greatest on the headlands, and the tendency is to deposit in the bays material thus eroded.

When a shore is growing by means of the along-shore distribution of detritus brought down by rivers (*e.g.* the coast of North Carolina), the coast-line becomes indented by the growth of sandy forelands, as explained in the last section. The indentation proceeds until the loss of material from the lengthened coast-line is equal to the supply. Now, the forelands grow where the supply is greatest, but as they are built out, the exposure, and consequently the rate of removal at the point, increases. At length, therefore, the indentation of the coast reaches a maximum. If subsequent scouring of the points and accumulation in the bays should shorten the coast-line, deposition would then be once more in excess of removal, and the forelands would be renewed.

The curves of a coast-line, so far as they are due to erosion and deposition, record the *relative* rates of recession (or advance) in different parts. Thus, where a foreland has grown out more rapidly than it has broadened (*e.g.* where rippling action deposits sand off the point below low-water mark, as in the cuspate forelands of Carolina), the curves of the coast are concave to the sea, and the foreland is sharply pointed at their intersection (Fig. 15, A). When the scour off the point begins to

FIG. 15.—COASTAL CURVES.

tell, the foreland is blunted, and the curve of the coast has an inflection (B). When the rate of seaward growth steadily diminishes with increase of size, as is likely to occur when a delta is built out by a river, the curve is everywhere convex to the sea-front (C). When one side of the foreland is more exposed than the other (D), it is common to have the curve C on the exposed side, and the curve A on the sheltered side, as at Dungeness. In this instance the whole form shifts bodily to the left in sympathy with the progressive deflection of the mouth of the Rother (see *ante*, § 9).

(*g*) MANGROVE COASTS.—The growth of deltas and forelands of sand and silt is facilitated where the mangrove and courida grow. The latter, according to Mr. J. Rodway, is the more effective in building out the shore.† In the first place, the roots direct the water into many devious channels, greatly increasing friction, and causing streams following opposite courses to meet and still each other. In the second place, *by yielding and recovering in the moving fluid, not rhythmically but*

* See James Thompson on "The Windings of Rivers in Alluvial Plains" (*Proc. Roy. Soc.*, 1876, p. 5, and 1877, p. 356).

† 'In the Guiana Forest,' 2nd edit.

confusedly, the vegetation produces tumultuous stirring of the waters, which is eminently favourable to the deposition of sand. In a somewhat similar way, waving reeds and grass stop sand driven by the wind. Planting has succeeded best as a means of stopping the encroachment of blown sand, and our sandy coasts might be similarly protected against sea-attack by sturdy plants with matted or tangled structure, and the habit to withstand salt water at their roots. Such growths appear to be at present unknown much beyond the tropics; nevertheless, this mode of protection from sea-attack might afford scope for interesting experiment in colder climates.

In the fascine dam, withies, and the like, by their yielding and subsequent recovery, reproduce one of the features of protection by a natural wall of matted mangrove or courida.

Postscript.

The next paper which I hope to lay before the Society will be upon undulating Waves, a subject upon which I have been engaged for some time past. I endeavour to deal with waves of the sea, of lakes, and rivers; with ripple mark and ripple drift and snow ripples; with gusts of wind, and undulating air-waves and their accompanying cloud forms, with the ridging of hillsides, and with such other rock (and ice) structures as are dynamically related to undulating waves.

I shall be grateful for any help which gentlemen interested in these matters may be kind enough to afford me, particularly—

(1) By suggesting problems for investigation.

(2) By assistance in mathematical treatment.

(3) By the loan of, or reference to, photographs and other illustrations.

Before the reading of the paper, the President said: Mr. Cornish gave us a very interesting paper last year on the formation of sand-dunes, which was followed by an admirable discussion, and I feel sure that the paper he is going to read to us this afternoon will be equally interesting. I will now ask Mr. Cornish to read his paper.

After the reading of the paper, the following discussion took place:—

Dr. Blanford: I am afraid I cannot contribute anything of value to the discussion. It is very difficult indeed to discuss papers of this sort, which require a great deal of reading and thinking over before any one can form a judgment upon them. Of course, this paper consists partly of facts, some of which are patent to any one who looks for them, and some are less obvious, and partly of conclusions formed by the observer, and it is not fair to attempt to criticize his views without going very carefully into them. I can only say they are exceedingly interesting, and I am only too happy on this occasion, as on a former one, to bear witness to the interest of the paper.

Mr. A. Strahan: England is not very large, and if it were not for its shingle beaches, it would be undoubtedly a great deal smaller. They are the best protection to our shores that we can have, and the subject is therefore of much importance from a national point of view as well as a scientific problem. The application of Mr. Cornish's views to a particular example is of great interest. The example I know best is the Chesil Beach, and it would be difficult to find a better specimen of a graded shingle bank. Mr. Cornish, I hope, will forgive me when I say that I do not entirely agree with him, or perhaps I should express myself more correctly if I say that I think he has not exhausted the subject. There is a copious literature on the Chesil Beach, beginning with a paper by Sir John Coode, and including a very fine piece of work by the late Sir Joseph Prestwich. There are great

difficulties in accounting for several features in the beach. In the first place, where did the material come from? in the second place, how is it now being supplied? and in the third place, why does the beach maintain its curious position at all? The beach extends from Portland to Eype, near Bridport, and is completely hemmed in at either end; nothing but the finest stuff can escape. I think Mr. Cornish will agree with me that only the finest material can escape round Portland, and that nothing but the finest stuff can be fed in, as he says, round the headland at the west end of the beach. The beach, for much of its length, is separated from the mainland by a long lagoon of shallow water 12 miles long, and cannot, therefore, be fed with stones from that part of the mainland. It seems, then, that it is starved at both ends and in the middle, and that some other sources must be found for the stones composing it. The stones themselves consist principally of chalk-flints, though there is no chalk anywhere in the neighbourhood; not anywhere so near, at any rate, as to supply flints. Amongst the stones, moreover, there are some quartzites, which must have come from Budleigh Salterton, a distance of some 20 or 30 miles. The theory formed by Prestwich to account for such stones was that they were washed into the sea from some part of the Devon coast, and brought direct to form the raised beach of Portland; that they were driven thence by storm-waves on the southern end of the Chesil Beach, and travelled in the beach north-westwards. It was supposed, also, that as they were carried they were worn smaller and smaller, and eventually passed almost into sand at the extreme end of the beach. But it always seemed difficult to me to understand how such large pebbles could get across Tor Bay. What could move them when they had got beyond the sphere of the waves? There is, however, an alternative source for these pebbles; the Tertiary strata of the Hampshire basin extend to the neighbourhood, and in a former period not improbably touched the rocks in which these pebbles are *in situ*. At any rate, they contain foreign stones of great variety, derived from that origin. Later than these, though of course altogether pre-historic, there is a set of gravels which once overspread a large part of this area, but which have now been cut by denudation into isolated patches; in those gravels I have myself seen such pebbles embedded. Now the sea is encroaching by slow degrees upon this coast. There still exist two hills on the landward side of the valley of the Fleet occupied by these gravels, and there can be no doubt that before the sea encroached upon the seaward side of that valley, there was there also a corresponding set of gravels, and that they may just as likely have contained these quartzite pebbles as the gravels on the north side. I regard the Chesil Beach, therefore, as having been formed from the sweepings of all the gravels and of the harder residuum of the rocks that once occupied the west bay, heaped up into a ridge. No doubt these stones oscillate, but I consider they are, and always have been, hemmed in effectually at each end, and that the beach is not fed from any other part of Tor Bay, but has been derived solely from the actual region in which it occurs. If the beach were fed from outside, it seems to me inevitable that it should pile itself up towards its eastern end in the direction in which it travels, and that eventually it would assume enormous dimensions. Under such circumstances it would take the form of a series of banks, such as form the promontory of Dungeness, an example of a beach which is continually growing. The only direction in which the beach can persistently travel is towards the shore. In a storm sooner or later waves reach to the top of the bank, and throw the stones on it, or even over it. There is a case on record of a ship having been thrown so high up on the beach that it was decided to launch her into the Portland Roads, as being an easier matter than to launch her into the sea again. Similarly, the stones roll over, and never get back again. They oscillate backwards and forwards with

east and west winds, but once thrown over the ridge they are safe. So that it seems to me that the beach is being rolled over upon itself towards the shore. Further, I think that it is travelling faster at the Portland end than at the Bridport end, and is therefore swinging; and, for this reason, that at its west end it is more or less covered with vegetation, but that at the east end it is completely bare. The raised beach at Portland Bill seems to represent the end of the beach when it extended in a curve 2 or 3 miles further out to sea than it now runs. The application of Mr. Cornish's laws to such a beach as this will be of the highest interest. It is impossible, in a discussion limited to time, to enter into matters of detail, but I feel certain that if he continues his careful investigations in the same spirit as he has commenced them, he will attain results of the highest value.

Sir Erasmus Ommanney asked if Mr. Cornish was acquainted with the accumulation of shingle round the extremity of Dungeness point, because all these sort of projections into the Channel are formed under different influences of tide and weather. According to a measure made from the point to the lighthouse, the shingle beach is advanced at a certain ratio of a few inches every year. Could he account for this accumulation continually going on there?

Prof. George Darwin: Having been one of the first to make experiments on ripple-marks, Mr. Cornish's paper has interested me very much. But, as Dr. Blanford has said, the subject is too large a one to discuss thoroughly after only once reading this elaborate investigation. I should, however, like to ask Mr. Cornish's view on one point to which he refers. On page 640 he gives a figure illustrating the eddies which are supposed to occur at the change of tide on an open coast-line. I should like much to know how these eddies were determined, and what reason there is for believing that there are two sets of eddies, one more seaward than the other; also what evidence there is for the existence of the nodal lines shown in the figure. No doubt he has authority, but the point is so interesting that it will be well worth while to give full details as to how the motion of the water was observed. The wrinkling of hillsides is one of the topics he proposes to take next; it was a subject in which my father, Charles Darwin, was much interested when he was studying earthworms. He was not quite able to make up his mind as to the origin of these longitudinal wrinkles. He concluded, I think, that they were largely, although not entirely, due to the action of sheep grazing sideways; but I do not suppose sheep would be able to make the longitudinal paths, unless the earthworms had given them a friable substance to trample down. If I remember aright, he thought that these wrinkles also appear without the intervention of animals; but it was not possible, in the cases observed, to determine the extent of the several influences which may produce them. In conclusion, I wish to congratulate Mr. Cornish upon his interesting paper, and to wish him success in his future work.

Dr. Mill: I am unable to speak as a specialist upon this question, but I should like to call attention to its national importance. Researches in physical geography have not been made in this country with anything like the frequency and detail that has been devoted to them on the continent, and latterly in the United States of America; and I think this Society should congratulate itself on securing a man like Mr. Cornish, who is prepared to devote his whole time to the study of questions like this. Much of the paper, of course, deals with matters which have been already studied by geologists, and, although the difference between the geological and geographical standpoint is not yet so generally understood in this country as it is, for instance, in Germany or in Austria, nothing can do more to prove the claims of geography to be considered an independent science than such researches, carried on from this point of view.

Captain Wilson Barker: I do not propose to offer any criticism upon the paper, but I should like to call Mr. Cornish's attention to the remarkable reefs on the east coast of Brazil, which are probably due to the action of the wind, and which I think are well worthy of his attention, and of the application of the theories which he has brought before us in this paper. They are commonly reported as coral reefs, but it is well known that they are nothing of the sort, but are formed of mud and sand of different kinds brought down by the rivers. In the trade winds, there is often a shifting of beaches with slight alterations in direction of the wind, so that at one time of the year you get it sandy, and at another time ordinary bare rock. The places I particularly allude to are at the landing-place, Fernando Noronha, and also in the harbour of Bahia, at the entrance. There is a remarkable bank of sand in the island of Gran Canaria, between Las Palmas and Port Luz, which, I believe—quite within ordinary memory—has grown very extensively, and is formed entirely of sand. The island of Gran Canaria is of volcanic formation, and it is difficult to say where the sand comes from. The popular idea is that it has been blown across from the African continent.

Mr. Cornish: I am extremely obliged to Mr. Strahan for giving at this time these further facts with regard to the Chesil Beach. Such a subject cannot be adequately treated from a single standpoint, and although I had read the papers of Coode and Prestwich, and, I think, the greater part of that extensive literature to which Mr. Strahan refers, I did not feel myself competent to analyze the geological evidence in the way he has done. With regard to the amount of the actual difference which there remains between Mr. Strahan and myself, it practically amounts to this: that I have supposed the shingle is travelling, while Mr. Strahan, I think, limits himself to the supposition that the shingle is oscillating on the beach, and that it neither comes nor goes at the two ends. Well, that is a point which I will not labour here, because investigations of the Chesil Beach will no doubt continue, and further evidence will, I hope, show which view is the more correct. In either case, as I have shown in my paper, it is the present and not the past conditions which mainly determines the present mode of grading. Admiral Sir Erasmus Ommaney has asked a question about Dungeness. In a part of the paper which I did not read, this curious accumulation of shingle is dealt with in some detail. I am extremely glad to have heard the remarks of Prof. Darwin, whose paper on "Ripple Marks" greatly helped me when I was struggling with the difficulties of this subject of the movements of incoherent material some two years ago. With regard to Fig. 10, the chief point which I wish to bring out is the *grid* pattern of the probable positions for deposition of sand under the conditions mentioned. The existence of nodal lines approximately at right angles to the shore is commonly recognized; *e.g.* in the case of the tides of the English Channel. With regard to the B nodes, parallel to the shore, I apprehend that these are necessarily established by reflexion, and *seiches* in closed seas and channels probably co-operate with tides (see Forel in 'Le Leman,' vol. ii., on the longitudinal and transverse *seiches* of the Lake of Geneva). A *grid* arrangement of sand formations has been noted by Prof. Osborne Reynolds in a tidal estuary, and by Major MacMahon in a mountain pass in the desert between India and Persia. In the open plains of Sindh the *stripes* (B) and *bars* (A) are not laid down together, but successively as the distance from the coast increases. Such considerations, however, do not enable one to construct a satisfactory figure, and I trust that Prof. Darwin, who commands mathematics, will go more deeply into the matter. With regard to the ridging of hillsides, the Down sheep walk on the flat top, and not on the sheep-sides, and that no doubt accentuates these ridges when once they are formed. But I have seen them equally well in the slopes of the valley at Grindelwald, and I have seen them near Innsbrück, and in other places where

apparently sheep do not go, and I have learned only to-day from one of the gentlemen of the geological survey that this ridging is very noticeable on the quartz screes in the Highlands, and yet other examples have been given me. Therefore, although curious structures may be produced by animals on hillsides, and although the remains of old agricultural workings will sometimes ridge a hillside, yet I think there is a true formation of pressure ridges, which, I may take it, would be analagous to undulating waves, independently of any effect that animals may produce.

Prof. DARWIN: I only meant that my father could not distinguish what part of it was due to the sheep, and what was due to some natural ridging. The difficulty was to eliminate one cause from the other.

Mr. CORNISH: I am much obliged to Captain Barker for pointing out certain interesting formations, and I shall hope to examine into them. In conclusion, I can only thank the gentlemen present for the kind way in which they have received the paper, and to express my gratitude in the usual way by asking for further help in connection with the paper that is coming.

The PRESIDENT: I feel sure that every one present will fully concur in what has been said by Prof. Darwin, Dr. Mill, and the other gentlemen who have joined in the discussion, with regard to the importance and interest which attaches to these investigations, and also with regard to the merit which belongs to Mr. Cornish for the perseverance and ability with which he has conducted them. If Mr. Cornish attaches importance to what he has said about the shingle survey, we shall be happy to report the matter to Admiral Domvile, and I have no doubt he will give it favourable consideration. If the expenses would only consist of the postage, I feel sure that matter would be easily arranged. I now propose a vote of thanks to Mr. Cornish for his valuable paper, and beg to assure him, on the part of the meeting, that we all look forward with great pleasure to hearing the other paper he has promised us.

Mr. CLEMENT REID (writes): I have read with great interest the proof of your paper on "Sea-Beaches and Sandbanks." It contains the explanation of many familiar coastal phenomena, the reason of which I have never clearly understood. There are only two criticisms that I should venture to make, and these may have been taken into account, though the paper is perhaps not quite clear on the point. I would suggest that it might be well to emphasize the fact that, contrary to the ordinary teaching of engineers, large shingle-beaches and sandbanks have not reached an equilibrium. As the last change of sea-level only took place in Neolithic times, and probably only some three thousand years ago, there has not yet been time for such a balance to be attained. The enormous accumulation of beach at Dungeness during the historic period shows that this historic period is no inconsiderable part of the total life of the beach.

The other point is, that the erosion of old gravel deposits at a low level has probably supplied a very large part of the material of some of the beaches analogous to the Chesil beach. In Cley beach, for instance, the accidental preservation of a single outlier of the low-level gravel in the middle of the beach preserves evidence which in a few years will be entirely destroyed. Without this it would be imagined that the whole beach was derived from one of the ends, instead of owing its origin to gravel outliers formerly in the immediate neighbourhood.

In your account of the Chesil beach, you do not allude to the fact that great part of the large pebbles at the eastern end are tough Budleigh Salterton quartzites. I should think that the life of one of these is many times the length of the life of a flint pebble—the one is slowly *rubbed* down, the other wears more rapidly by small conchoidal fractures. The proportion of these quartzites is so large towards Portland, that I suspect the nature of the material has here a good deal to do with the size of the stones.

THE LOB-NOR CONTROVERSY.*

When Dr. Sven Hedin made, in October last, a communication to the Russian Geographical Society on the discovery of what he considers to be the true historical Lob-nor, a lively discussion ensued. P. K. Kozloff, who knows the region well, as he has visited it more than once as a companion of Prjevalsky, and as a member of the last Tibet expedition, took an important part in the discussion, and now he sums up his arguments in a paper published both in the *Izvestia* of the Society and as a separate pamphlet.

The controversy, as is known, is about what is to be considered as Lake Lob-nor. No lake is called Lob-nor by the natives; they give that name to a whole region. Prjevalsky discovered an elongated lake, Kara-koshun-kul; also Kara-buran, which runs west-south-west to east-north-east in 89°–90° E. long., its south-western extremity being 35 miles south of 40° N. lat. It became known since that this lake is continued towards the east-north-east by an old lake-bed, as far as 91° E. long. On the other hand, Sven Hedin discovered a chain 30 miles long, composed of four small lakes, running north to south in the north-west of Prjevalsky's Lob-nor. Kozloff had, two years before Hedin, visited the southern lake of this chain, which lies almost under the 40th degree of latitude; but Hedin went along the eastern shore of the whole chain.

When Prjevalsky's discovery became known, Baron Richthofen contested it. He maintained that the Kara-koshun-kul cannot be the Lob-nor, which has a more northern position on a Chinese map of the region; and now Sven Hedin claims that the chain of lakes which he has discovered along an old bed of the Konche-daria must be a relic of the Lob-nor, which formerly extended in that latitude further east; while the Kara-koshun-kul is but a temporary and recent formation, which, indeed, has much decreased since Prjevalsky's first visit in 1884–85, while the northern chain of Sven Hedin's lakes has increased since. This northern chain occupies, as to its latitude, the position given to Lob-nor on the Chinese map. Richthofen wanted, moreover, to identify the southern lake (Prjevalsky's Lob-nor) with another lake, Khas-nor (or Khas-omo), marked on the Chinese map.

P. K. Kozloff proceeds systematically in his paper, and gives in it all documents relative to the controversy; especially he quotes passages from the Chinese work, 'Si-yui-Shui-dao-tsi,' published in 1823, relative to the region, and gives a reduced copy of the Chinese map published by Dr. Georg Wegener in 1863, upon which map Richthofen and Sven Hedin based their arguments. He reproduces next the texts of Prjevalsky's description of the Lob-nor, as given in his preliminary reports and travels; the geologist K. Bogdanovich's description of the same, as well as abstracts from his own diary relative to his visit, in 1893–94, to the region of the lakes discovered by Sven Hedin, and of the sandy deserts where the old bed of the Konche-daria is still seen in the north-east of Sven Hedin's lakes. He reproduces, also, the text of Hedin's description of the lake, and his remarks and arguments in favour of his hypothesis (taken from his paper, "Das Lob-nor Problem"). Finally, he publishes a map of the region, upon which all new discoveries and the journeys of Sven Hedin and Kosloff are marked. This map, alone, would be a weighty argument in the controversy.

Prjevalsky's description of the Lob-nor is well known to English readers, and it need only be mentioned that when he questioned, in 1885, during his second journey, the natives settled on the Lob-nor as to the possible existence of another lake situated northwards, they all replied in the negative, explaining at the same

* Map, p. 692.

time that, according to tradition, the lake was always situated in the same spot where they now lived.

In the autumn of 1890 the Lob-nor was revisited by the Tibet expedition of M. V. Pevtsoff; and as his description was never published in English, some abstracts from it are reproduced here.

"The lake of Lob-nor," wrote General Pevtsoff, "represents, according to the unanimous testimony of the natives whom I questioned, a large basin, mostly covered by thick and unusually high rushes, which reach in some places the height of 28 feet, and a thickness of more than an inch. It has an oval shape, and its longer axis runs from the south-west to the north-east for more than 62 miles; its width is about 25 miles. Kunchikan-Bek, who went round the lake, informed me that he made the journey in five days, travelling at the rate of about 30 miles a day. This Bek asserts that the lake is surrounded by a vast uneven area of clay, impregnated with salt, quite sterile, and covered in places with shells. Riding on its uneven hardened surface is very difficult, and only possible near the edge of the rush, where the ground is softer and more even. In vain did Kunchikan-Bek look out for convenient spots for settlements on the shores of Lob-nor. He found none.

"In the south-western portion of the lake, near the mouth of the Yarkand-daria (Tarim), there is an area of about 7 miles in circumference, which is free from rush-growth, and where the depth is 14 feet. But of such large open basins there are few, the rest of the spaces not covered with rush being much smaller. The same portion of the lake contains a narrow channel of about 13 miles long, in which one notices a very weak current of fresh water from the Yarkand-daria (Tarim), but on both sides of this channel the water of the lake is slightly salt.

"According to the unanimous testimony of the natives, the lake Lob-nor is becoming more and more shallow every year. The old folk still remember that it was much larger and contained incomparably more open areas. In the village of Abdal, situated 2½ miles above the mouth of the Yarkand-daria (Tarim), there lived during our sojourn a man, 110 years old, named Abdul-Kerim, who represented living annals of the physical changes which took place in the lake during his long life. He was still healthy and walked about freely, but he spoke so indistinctly that only his son, Arkhei-jan, fifty-two years old, could easily understand him, and with him we often spoke of the old times. The latter transmitted from his father to me that great changes had taken place in the Lob-nor since his father's youth. The old man said that he would not have recognized his country if he had spent his life abroad and had returned home in his old age. The lake Lob-nor, during the young days of Abdul-Kerim, *i.e.* more than ninety years ago, was in its south-western portion free from the rush, which grew only in the shape of a narrow rim along the flat shores, while the open area of water in the lake was spreading to the north-east as far as the eye could see. The mouth of the Yarkand-daria at that far-off time was 2½ miles more to the west than the present one, just opposite the spot where Abdul is situated now.

"The depth of the lake was much greater than it is now, and on its shores there stood many villages, from which hardly any traces are left now. In consequence of the gradual shrinking of the lake and its getting grown over with rushes, the inhabitants of these villages were obliged to leave their sites and to settle on the lower Cherchen-daria. Thus were deserted, one after the other, the villages Tur-kul, Bayat, Lob, and Kara-koshun.

"The river Yarkand-daria (Tarim), in accordance with tradition, was flowing two hundred years ago more to the north than it now flows in its lower part, and it discharged itself into a small lake, Uchu-kul, which communicated with the

Lob-nor by a channel. This tradition was confirmed by the old man, Abdul-Kerim, who heard of it from his grandfather, during whose life the river ran still in the just-mentioned place, and afterwards changed its channel. The ancient bed of the Yarkand-daria, called at present Shirga-chapkan, is clearly visible up to the present time. There are still, here and there, stumps of trees which grew on the shores of the river. . . .

"Twenty-five miles to the south-west from Lob-nor lies another large lake, Kara-buran (black isthmus), about 38 miles in circumference.* This lake (Kara-buran), like Lob-nor, is mostly covered with high rushes. In its western part there are, however, several open areas of sweet, unusually clear water reaching 5 miles in circumference, the depth being up to 28 feet. . . . The Kara-buran is fed by the waters of the Yarkand-daria (Tarim) and the Cherchen-daria, of which the first flows into its north-eastern part, and the last one into the western part. . . .

"All along the Kara-buran, from the very mouth of Yarkand-daria, there runs, amongst the growth of rushes, a narrow channel, widening in places into lakes. In this channel a weak current is to be noticed, and one can row on it in a boat.

"The Yarkand-daria, on issuing from the lake Kara-buran, carries pure and fresh water, which, however, is not so clear as in the lake itself. This river, on the whole distance from Kara-buran to Lob-nor, has a winding bed and rather high shores, but its width does not exceed 175 feet. It flows with a velocity of about 4 feet in the second and is everywhere very deep; its length between the lakes, counting with the windings, attains 38 miles. . . .

"About 32 miles from Chighelik, near the spot Kabagassy, the Yarkand-daria receives from the left a branch of the Konche-daria, which contains plenty of water, and forms in its course a chain of four lakes. In 1880 the Konche-daria, about 22 miles from its mouth, has opened for itself a channel in a south-eastern direction into a valley, which further on turns to the south. On its way along this valley it has formed four deep lakes—Chivelik, Sogot, Talkeichin, and Tokum-kul, each of them from about 3 to 4 miles long, and about 1 or 2 miles wide, covered on the shores with high rushes. . . ."

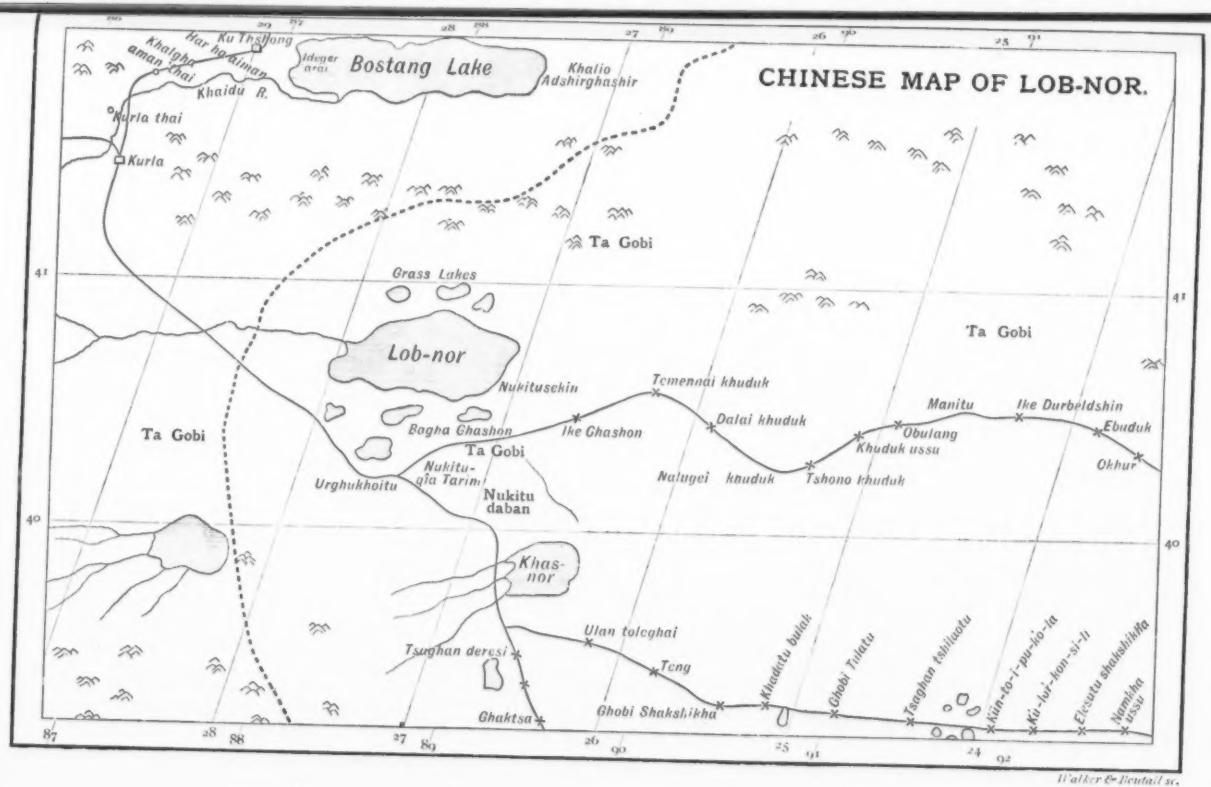
After having reproduced the above important extracts from General Pevtsoff's work, Kozloff gives an excellent picture of the present state of Lob-nor, and very interesting conjectures as to its former development by the geologist of the Tibet expedition, K. T. Bogdanovich.† According to the observations of Bogdanovich, there are in the Lob-nor region doubtless dunes whose characteristic distribution in rows could not be accounted for otherwise than by supposing that they mark an ancient shore-line of the Lob-nor.

Kozloff gives next extracts from his own and Roborovsky's descriptions relative to the region, his visit to the southern lake of the chain of lakes discovered by Sven Hedin, and reproduces in full Sven Hedin's interesting description of the part of his journey which he made along the eastern shore of the lakes and his discovery, as given on pp. 305–361 of vol. xxxi., 1896, in the *Zeitschrift* of the Berlin Geographical Society, under the title of "Das Lop-nor Problem." The cartographical results of Sven Hedin's investigations are given by Kozloff in the map (p. 655), which is reproduced from the *Izvestia*.

After having thus brought before the reader all the necessary materials for forming an independent judgment, Kozloff takes one by one Richthofen's arguments. To the argument based on the fact that the Kara-koshun-kul is a fresh-water lake, while the Lob-nor is a salt lake, Kozloff replies that the Kara-koshun-kul

* Kara-bouran, according to Prjevalsky (Kozloff).

† 'The Works of the Tibet Expedition' (Russian), part ii., 1892, pp. 95–100.



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contains fresh water only in the channel of the Yarkand-daria, which flows through it. As to the borders of the lake where the water does not flow, it is slightly salt, and further to the east it becomes more salt, even bitter. This was pointed out by Prjevalsky, Pevtsoff, the Prince of Orléans, Sven Hedin, and Kozloff himself. The further one proceeds from the spot, where the Yarkand-daria enters the Kara-koshun-kul, the more salt is the water, and at last even the camels refuse to drink it. The drying-up bottom of the lake is impregnated with salt, and areas of clay impregnated with salt surround it. All this is in accordance with both the historical facts and with theory.

The main argument of Richthofen was the Chinese map upon which the Lob-nor is marked one degree further north than Prjevalsky's Lob-nor. This is true, Kozloff says, but the map is wrong. The position of the spot Airylgan, where the Konche-daria joins the Tarim, was already determined by the Jesuits in 1760–65, and was found to be 40° 2′ N. lat. and 87° 23′ E. long. Its true position, as determined by General Pevtsoff, differs very little in latitude from the Jesuits' determination: it is 40° 8·7′ N. lat. and 88° 20′ E. long. And yet the Lob-nor was placed on the Chinese map much further north.

Richthofen wanted also to identify Prjevalsky's Lob-nor with the Khas-nor on the Chinese map; but the country in the south of Lob-nor is not flat on the Chinese map, as it bears between the Lob-nor and the Khas-nor an inscription, "Nukitu dahan," which means "Nukitu pass." So it is in reality, as seen from V. M. Uspensky's paper, "The Land Kuke-nor or Tsin-hai," * compiled from Chinese sources, in which paper the Nutsitu range of mountains is mentioned. The lake Khas-omo of Richthofen and Khas-nor of the Chinese map is evidently Prjevalsky's Lake Ghas, and this was pointed out at once to Sven Hedin by the Russian geographers. It also has in reality a more southern position than on the Chinese map (38° 7′ instead of 38° 15′). If the latitudes be corrected on the Chinese map according to recent determinations, the whole argument based on the Chinese map falls to the ground, Kozloff remarks.

Kozloff analyzes next Hedin's arguments based on the old course of the Konche-daria (or Kum-daria), which Kozloff visited under the 90th degree of longitude and mapped; these arguments—although very interesting—are too lengthy to be reproduced in full, but he words his conclusions as follows:—

"The Konche-daria thus took formerly a more eastern direction. Gradually its course was more and more diverted southwards, as is proved by the old beds which are now seen between the old Konche (Kum) daria and its present bed. After having thus turned full 40 to 45 degrees to the right, it took its present bed toward Airylgan, where it joins the Tarim. At any rate, even in those remote times the river flowed towards the lowest part of the desert which it watered—that is, into the Lob-nor.

"There was undoubtedly a time when the Lob-nor spread much more northwards than it does now; its western shore lay along the line Urten—Abdal—Airylgan, as is proved by the only dunes preserved in Kashgaria (see Bogdanovich's reports). As to the southern shore of Lob-nor, it occupied approximately the same position as it has now, and along it ran the road from Lob-nor to Sa-chau, which was followed six hundred years before me by Marco Polo.

"In the upper part of its shifting course, between Gherelgan and Turpan-korul, the Konche-daria shows some old dry beds, but has now a defined water-course. In the swamps adjoining Tykenlik we have the first store-basin, in

* *Memoirs (Zapiski) of the Russian Geographical Society*, "Ethnography," vol. vi. 1890.

which a first transmission of water takes place from the Konche to the Tarim—that is, to the Kunchikash-tarim, which joins the Yarkand-tarim at Airylgan, and which, therefore, the natives quite rightly named Konche-daria to Prjevalsky. The investigations made by Sven Hedin in the spring show that two-thirds of the water of the Konche-daria runs in cascades into Kok-ala, and only one-third continues to move in the former direction in a deep bed, bending abruptly in its lower half towards the south. From this remarkably long old bed—Ilek—a comparatively small branch flows into the Kunchikash-tarim above Airylgan, and a still smaller one below Airylgan to join the Yarkend-tarim. Such was, I believe, in a broad outline, the scheme of the Konche-daria before the lakes discovered by Sven-Hedin had been formed.

"The level of the water in the Konche-daria stood then somewhat higher than it stood in the Tarim, as is now the case near Tykenlik, where the Konche-daria falls in cascades into Kok-ala. From nine to fifteen years ago, the waters of the Konche-daria, always deflected westwards, so as to approach, so to say, the Tarim, came down almost to the same level as this last. At that time, just in the middle of Kunchikash-tarim, where the shores are comparatively not high and solid, a trench was formed, as the natives say, and the water ran back to the old bed Ilek, inundating the sandy and salted depression of Chivellik, and thus revived the nearly dried-up lake-shaped valley of the Ilek, which the natives now began to name Avyulu-kul, Kara-kul, Sogot (Arka-kul), etc. A great portion of the water, however, again returns down the nearest old bed to the Yarkand-Tarim, while a very small portion only flows further down, along the more distant part of the old bed, where most of the lagoons were entirely dried up. I consider that such an abnormal deviation towards the east is merely temporary; the sand and the wind, working hand in hand, will necessarily soon raise the bed of the river, and they will thus deflect the water in its proper direction towards the west. Then the lake-shaped old bed will again begin to dry up, and while this will be going on, the Kara Koshun-kul—that is, the true Lob-nor—will continue to be further reduced in size. But several water-arteries will finally join in the principal one, the Chu-tarim, although, of course, unimportant fluctuations may take place in the mean time.

"More serious changes will happen in the future, when the Tarim will join the Konche-daria in the meridian of Kurla, and will flow in its lower part again in the bed of the Ketek-tarim, while the present basin of Lob-nor will move also south-westwards, and will form something in common with the present Kara-buran, spreading at the same time to the north and to the east; but it will hardly abandon the salty depression which from time immemorable was the bed of Lob-nor, and maintains this historical name."

Kozloff's final conclusions are the following: "The Konche-daria, since very remote times till the present day, has moved a long way. The spot Gherelgan may be taken as a spot of relative permanence of its bed, while the basis of its delta is a line traced from the farthest northern border of the area of salt clays surrounding the Lob-nor to the Tarim. At a later period the Konche-daria mostly influenced the lower Tarim, and each time a change occurred in the latter's discharge, the Konche took a more westward course, to the detriment of its old eastern branch (Ilek). Always following the gradually receding humidity, the vegetable life changed too, while moving sands were taking its place, conquering more and more ground for the desert, and marking their conquest by remains of old shore-lines. . . .

"The facts noticed by Sven Hedin have thus another meaning—the desert in the east of the lakes, which he discovered, was formed, not by Lob-nor, which is situated 1° southwards, but by the Konche-daria, in its unremitted deflection

to the west. The old bed Ilek, lake-shaped in places, and having a belt of salt lagunes and swamps along its eastern shores, represents remains of waters belonging, not to Lob-nor, but to the shifting river which has abandoned this old bed.

"These facts and explanations refute the second point of the arguments which were brought forward by Sven Hedin in favour of his hypothesis, asserting the existence of some other Lob-nor.

"I accept the third point of his objections, namely, that the grandfathers of the present inhabitants of the Lob-nor lived by a lake whose position was more to the north of Lob-nor; that was mentioned already by Pevtsoff, and the lake was Uchu-kul.

"Why Marco Polo never mentioned the Lob-nor, I leave to more competent persons to decide.

"The only inference which I can make from the preceding account is that the Kara-koshun-kul is not only the Lob-nor of my lamented teacher, N. M. Prjevalsky, but also *the ancient, the historical, and the true Lob-nor* of the Chinese geographers. So it was during the last thousand years, and so will it remain, if 'the river of time' in its running has not effaced it from the face of the Earth."

NORTH-EAST NICARAGUA.*

By JOHN M. NICOL, C.E.

NICARAGUA has only been half explored, and very few surveys have been made; the latter have been mostly done by compass, with the exception of those for railway and canal work. The accompanying map is copied from a reduction of the Government map, with some alterations made after going through the country myself, and after collecting all the reliable data I could get. It is, of course, not correct, but is probably the most reliable extant. The red lines indicate my various routes. I also travelled, by canoe, up the rivers Coco, Wasspook, and Pis Pis from Cabo Gracias to the Pis Pis mines, and on foot from the mines to Matagalpa. This journey took me nearly two months, and as the country is almost uninhabited, and covered with dense forests, we were often short of food, living principally on monkey meat. The area within the dotted red line is almost all of a gravel formation, with pine forests and grass land, very healthy, and free from insects.

BLUEFIELDS.—The real harbour here is just inside the lagoon behind the bluff; Bluefields town is situated on the further and shallow side of the lagoon, and is quite inaccessible to craft drawing over 14 feet of water, and even these often drag on the oyster-beds. The only way to save the town, and place it in direct communication with the steamers, would be to throw an embankment across the channel separating Deer island from the mainland, where the shallow water is only from 2 to 3 feet deep, and abundance of the necessary material could be obtained behind Bluefields. On this embankment and on a second at the other end of Deer island a tramway could be laid down, thus connecting the town with the small island opposite the bluff; and, if necessary, a further anchorage could be dredged where are now the oyster-beds, or a regular harbour could be constructed there.

The present bar averages 12 to 14 feet of water. Bluefields is a healthy little town of about 3000 inhabitants; it is well laid out on high ground, and has plenty of room for expansion. According to Dr. Garces, the Government engineer, it is

* Map, p. 692.

possible to make a railway from Bluefields to the interior without crossing any swamp.

Rio Grande.—The mouth of this river offers no real harbour, as there is a bad bar, averaging only 7 to 10 feet (8 feet when I crossed), and even if the bar were deepened, it would still be bad, as, the mouth being quite straight, the swell would penetrate for a long distance; besides this, the enormous quantity of *débris* brought down by the river, and the constantly shifting sandbanks at its mouth, would always cause great expense, if an attempt were made to keep open a good harbour here. Further, as the whole country round consists only of flat lowlying sands, with marshy pools and large areas of mangrove swamps, there is no site suitable for a town, nor for the construction of docks, etc., and a railway would be almost out of the question, owing to the swamps. At present there are two jetties, some Government buildings, about thirty houses, and one large and three small stores. There will always be a good traffic for coasting vessels of small size, as for a long distance the river is deep and navigable, and for a considerable mileage has an average depth of 20 feet, with a width of 300 yards.

An American company has a concession giving it an exclusive monopoly over the cutting and export of mahogany and cedar from this river; the company owns a twin-screw, two-masted, sea-going tug, called the *Yulu*, drawing about 7 feet of water. This boat can go as far up as the steamer limit marked on the map, and also makes trips to Bluefields, Rio Prinzapulca, and up the Wawa river. Above the steamer limit there are bad rapids, and navigation by canoes is even difficult.

Rio Prinzapulca.—This is only a river mouth with a bad bar, where there is often only 6 feet of water; the anchorage is bad, the river being narrow and the current swift and strong—so strong in flood-time that, when I was there, the schooner dragged her kedge and began drifting. The *Yulu* has been—in flood—as far up as Tungla; but often she has difficulty in getting over the bar. There is a stern-wheel steamer, the *Progreso*, plying regularly on the river; in flood she goes as far up as Tungla, but in dry seasons only as far as the steamer limit marked on the map. At present it takes from four to six days to descend the river from Wani by "pitpans" (dug-out canoes) and steamer, and from ten to fourteen days to go up, as the pitpans are slow travellers. Prinzapulca town is built on the swamps at the mouth of the river, and consists of about fifty wooden houses and shanties with galvanized iron roofs; the houses are built on posts, and the wooden side-walks are on posts, as the town is surrounded with swamps, and during floods the water runs under the houses. There are nine fairly large and well-stocked stores. There will always be a considerable trade carried on here, as the river is a natural, though bad, highway to the mines of Pis Pis, Siuna, and Quiquina.

Rio Kukulaya and the Waunta Lagoon.—This river is marked as large and important on the existing maps, though, according to the best information I can get, it is only a small river discharging into a lagoon, into which a few other small creeks drain; but there is no navigable water, except for Carib craft and canoes.

Rio Wawa.—This is a good-sized river, and navigable for quite a long way up. The harbour is comparatively good, the bar averaging 10 feet of water, with sometimes more; the river makes a sharp bend to the north just inside the bar, and is a safe anchorage for small craft in all winds; the sandbanks are a little higher and less swampy than either at Rio Grande or Prinzapulca. This, without any great expense, could be made into a good coasting harbour, and with steamers on the river would soon develop into a place of some importance, as it would be the nearest point to the mines of Pis Pis. The river, a short distance up, opens out into an extensive lagoon; still farther up the river is bounded by extensive forests

of tropical screw-pine and pitch-pine, where for some time a steam saw-mill has been established, which supplies lumber to the coast towns. The steamer *Yulu* comes into the river frequently for cattle and lumber, and can go as far up as the steamer limit marked on the map. At the mouth of the river there is only a very small settlement, consisting of about ten houses and one small store.

Bragmans Bluff.—This is a rock promontory of high ground, the highest point being probably over 100 feet above the sea; it is covered with forest, and connects with the mainland by a strip of solid ground between the swamps, which spread widely to the right and left. This point offers a shelter to vessels in north and north-west winds; there is deep water up to 3 and 4 fathoms close to the beach, and within one mile out there is 10 fathoms. By constructing a breakwater, a harbour for ocean-going steamers could be made here, with freedom from the shifting sands and strong currents of the river harbours; also the high ground would make a good and healthy site for a large town, and it is probably the only place on this part of the coast where a railway could be brought down to the sea without crossing swamps.

Krapakia Lagoon.—This is a fine large salt-water lagoon connecting with several others. There is 9 to 10 feet of water on the bar, with deeper water inside. The lagoon is surrounded with impenetrable mangrove swamps; but small stern-wheelers could ply up the Krapakia creek as far as Krapakia village, where pine trees and solid ground commence.

Cabo Gracias à Dios.—This point lies to the south of the main mouth of the Coco or Wanks river. The town is situated on the inland shore of a lagoon 2 or 3 miles further south. The entrance to the lagoon is very shallow, with 3 feet of water, whilst the lagoon has only from 2 to 6 feet; a narrow and shallow channel connects this lagoon with the Coco river, and through this passage all the canoe traffic is carried on. One hundred years ago this was a fine harbour, but it is silting up so rapidly that it will soon be nothing but a swamp. The steamers that touch here, and even the coasting craft, have to anchor outside, and the loading and discharging is carried on by dug-out sea-going canoes.

Coco River.—This river has three mouths, besides the channel into Cabo Gracias lagoon; all the entrances are shallow and bad, which is unfortunate, as the river would be navigable for quite a long way up (see map). It is one of the largest rivers of Central America, averaging 200 to 300 yards wide, in some places 500 to 600 yards, but at its delta with only 2 to 3 feet in depth. At Andres, in flood, I have seen the water up to the houses, and 15 feet above normal level.

THE MONTHLY RECORD.

THE SOCIETY.

Honour for the President.—The King of Sweden and Norway has conferred upon the President, Sir Clements Markham, K.C.B., the honour of Commander (first class) of the Order of the Polar Star, on account of the valuable assistance and advice which he has on many occasions rendered to His Majesty's Government.

Awards of the Society for 1898.—The gold medals and other awards to distinguished travellers have been adjudged this year as follows: The Founder's Medal to Dr. Sven Hedin, for his important exploring work in Central Asia, and especially for his survey of the glaciers of Mustag-ata,

for being the first explorer to cross the Takla-Makan desert, for his discovery of a new route south of the Kuen-Lun range, and for his investigation of the physical geography of the Lob region. The Patron's Medal to Lieut. R. E. Peary, U.S.N., for his explorations in Northern Greenland, dating from twelve years ago, and especially for his memorable sledge journey across the Greenland ice, and for his discovery of its northern termination. The Murchison Grant for 1898 has been awarded to Mr. H. Warington Smyth, for his important journeys in Siam; the Back Grant to Mr. George P. Tate, for his surveys in Afghanistan and Beluchistan, especially Makran, as well as at Aden and on the Indus; the Gill Memorial to Mr. E. J. Garwood, for his geographical work in Spitsbergen during 1896 and 1897 in company with Sir Martin Conway; while the Cuthbert Peek Grant has been given to Mr. Poulett Weatherley, for his exploration of the country between Lakes Mweru and Bangweolo, and for his circumnavigation of the latter lake in his steel boat, the *Vigilant*.

The Vasco da Gama Celebrations.—The celebration of the four-hundredth anniversary of the discovery of the sea-route to India was inaugurated in Portugal on May 17, by the firing of a salute of 101 guns by the forts and ships anchored in the Tagus. Later in the day a grand naval review was held, the foreign warships sent to do honour to the occasion being visited by the king in person. The ships sent by the British Government were the *Magnificent*, *Prince George*, *Repulse*, *Mars*, *Jupiter*, and *Resolution*, forming the principal section of the Channel Squadron. The Royal Geographical Society is represented, during the ceremonies at Lisbon, by Lord Dunraven, who was named by the Council as the Society's delegate. In this country the occasion has been celebrated by a special evening meeting of the Society, at which their Royal Highnesses the Prince of Wales and the Duke of York were present. An address was delivered by Sir Clements Markham, in which the persistent labours of the Portuguese, under Prince Henry the Navigator and other members of the royal family of Portugal, to open a sea-route to the East were clearly set forth, and the events of Vasco da Gama's first voyage to India briefly described. After speeches from the Portuguese *chargé d'affaires* and Lord George Hamilton, the Prince of Wales read to the meeting telegrams of congratulation which had been exchanged between himself and the King of Portugal, and expressed, on behalf of the British nation, the cordial sympathy here felt for the celebrations then taken place in Lisbon. The Hakluyt Society has taken its part in the celebration by the publication, for the first time in English, of the 'Roteiro' of Vasco da Gama's first voyage, ably edited by Mr. Ravenstein, and illustrated by portraits of the Portuguese admiral, and by representations of his ships, and of places and objects of interest in connection with the voyage.

EUROPE.

The Seventieth Anniversary of the Founding of the Berlin Geographical Society was celebrated on May 25, a special meeting being held at 6 p.m., followed by a dinner in honour of the occasion. The celebration of the discovery of the sea-route to India was combined with the more special object of the meeting, papers being read by Dr. Sophus Ruge and Dr. Georg Wegener on "Vasco da Gama" and on "India of To-day" respectively, after an address by the President on the work of the Society during the last five years.

The Climate of London.—In a paper on the daily values of the non-instrumental meteorological phenomena in London from 1763 to 1896, published in the *Quarterly Journal* of the Royal Meteorological Society, vol. xxiv. (1898) p. 31, Mr. R. C. Mossmann continues his laborious investigation into the variations of local climate. The general results may be given under the head of each of the phenomena which is considered. Thunderstorms practically do not occur in London between October and April. The maximum frequency occurs in July, especially between July 14 and 20, but July 6 is credited with twenty-two thunderstorms, five more than are recorded for any other day. Mist and fog show an almost opposite seasonal distribution, dense fogs scarcely ever occurring between May and August, but becoming very numerous from October to December. The period of most frequent and also of densest fogs is from November 5 to 24, the 23rd having the highest record of dense fogs. Snow has been recorded in London in every month except June, July, and August. It is most common in January, February, and March. The period when snowstorms are most frequent is at the beginning of January, and again at the beginning of March. Hail is most common in April. Gales are most frequent at the end of January, the beginning of March, and the middle of December, and least frequent from May to September.

Geological Desert Conditions in the British Islands.—Mr. J. G. Goodchild has published in the *Transactions* of the Edinburgh Geological Society, vol. vii. (1897) p. 203, an interesting paper on "Desert Conditions in the British Islands." He first defines desert conditions as those induced by a rainfall so small as to be insufficient for the maintenance of any form of vegetable life not specially adapted by evolution to stand desert conditions, and, taking this limit as anything less than 10 inches per annum, he shows how characteristic is the action of denudation in deserts. Following Walther's researches, he points out how the increased radiation, due to the absence of water-vapour in the atmosphere, tends to the rapid disintegration of crystalline rocks by the different expansion and contraction of their constituent minerals. The sand so produced is rounded by wind-drift in an unmistakable manner, the grains being entirely different from those of sea-sand. Proceeding farther to consider the sedimentary rocks formed by the consolidation of desert sands, Mr. Goodchild carefully examines the various structures as preserved in the sedimentary strata, or as modified in the metamorphic rocks. From this he deduces the occurrence of several periods when desert conditions of climate prevailed in Great Britain. The New Red (Permian) rocks show, by their well-rounded sand-grains covered by ferric oxide, by their exaggerated false bedding, and by their breccias of rough blocks akin to the screes formed in wadies by sudden torrents, that at that period, when continental Europe was under water, our islands occupied the desert heart of a continental area. Similar evidence points to desert conditions having prevailed during a great part of the Old Red Sandstone (Devonian) period; the exceptional durability of the Caithness flagstones being due to their permeation by bituminous matter formed in the internal lake-basins of a desert. Mr. Goodchild finds evidence of

the most striking desert-period of all in the very ancient Torridonian rocks of the north-west of Scotland, which he finds to present striking analogies with the formations now being laid down in the Sinaitic peninsula. It need not be pointed out that the whole of this geological argument depends upon geographical conditions now prevailing, from the study of which evidence of past distribution of land and sea may be obtained.

Rainfall of Seathwaite.—The rainfall of Seathwaite in Borrowdale is perhaps the greatest in any part of the British Islands, and the records obtained during the fifty years 1845–94 have already been discussed by Mr. J. G. Symons, F.R.S. Mr. W. Marriott has a paper in the last number of the *Quarterly Journal* of the Royal Meteorological Society (vol. xxiv., 1898, p. 42), on the records obtained by the Seathwaite rain-gauge belonging to that Society from 1881 to 1897. The mean annual rainfall for the fifty years discussed by Mr. Symons was 137 inches; that found for the last seventeen years is 130 inches. The rainiest year in this period was 1882, when 146 inches were registered; the driest 1895, when the rainfall was just under 100 inches. The greatest recorded fall for any one day was 8 inches on November 12, 1897; but falls of 6 inches and over have been recorded at Seathwaite on eleven occasions since 1845. The heaviness of the rainfall appears to be proportional to the strength of the wind. The curious fact that Seathwaite lies on the sheltered side of the mountain barrier that faces the rain-bearing south-west winds, is explained by Mr. Marriott as follows. The wind, rushing up Wasdale and Langdale, is thrown up by the steep ascents at the head of those valleys, and continuing to rise and to move forward after reaching the summit-passes, the maximum cooling effect and consequently the maximum precipitation occur at a point directly over the sheltered valley on the lee side. It is interesting to note the difference between the action of rain-bearing winds on a mountain range reaching to or approaching the snow-line where all the precipitation takes place upon the exposed slope, with that on a barrier of hills like those of the Lake District, where the valleys of the lee side are subject to a heavier precipitation than the weather slopes.

A Local "Magnetic Pole."—At a meeting of the Academy of Sciences of Paris on May 9 (*Comptes Rendus*, cxxv. (1889), p. 1380), M. Mascart announced that Prof. Leist of Moscow had discovered a curious magnetic disturbance at Kochetovka, in the government of Kursk. At this place there was a point at which the horizontal magnetic needle pointed indifferently in any direction, and the dipping-needle was vertical. The phenomenon was so local that at a distance of 70 feet from the centre of vertical dip the declination decreases by 1°.

ASIA.

An Indian Province.*—Although many excellent accounts of India as a whole exist, the vast size of the country and its varying conditions of life make it impossible that these should deal in a satisfactory way with many points of detail respecting particular parts of the empire. An exhaustive study of a limited area, such as Mr. Crooke has supplied for the North-Western Provinces, is therefore of much value. The author, whose position as director of the Ethnographical Survey of the province has placed at his disposal a large amount of trustworthy information with regard to its inhabitants, has aimed chiefly at pourtraying the present condition of the people in its social aspect, but, in order to clearly explain their environment, he begins with a useful sketch of the land in its physical aspect. Although the fact that the area known as the North-West Provinces and Oudh is at

* 'The North-Western Provinces of India, their History, Ethnology, and Administration.' By W. Crooke. London: Methuen, 1897.

present a single administrative unit makes it convenient to treat the province as a whole, the author points out that its boundaries nowhere agree with the physical conditions by which it is dominated, and that its present frontier is neither ethnical nor linguistic. It includes in the north-west a portion of the higher Himalayan ranges, while in the east it does not even include the *tarai* at the foot of the mountains. In the south, again, it includes districts naturally belonging rather to Rajputana and Central India. It therefore presents extraordinary diversity of physical aspect, scenery, and climate, the only country with which a comparison is possible in this respect being Peru. Mr. Crooke describes in turn the three main, strongly contrasted, physical divisions of the province, the great plain of the Jumna and Ganges, which includes about 72 per cent. of the area and 89 per cent. of the total population, of course receiving the largest share of attention. In subsequent chapters the history of the province, the ethnology, social and religious life of the people, and their relation to their present rulers, are fully dealt with.

On the Geology of the Tian Shan.—We have received from Mr. George Macartney, the British Agent in Kashgar, the following geological notes made by Prof. Karl Futterer, who is at present engaged in the exploration of Central Asia. The geological observations show a striking difference between the structure of the western and central parts of the mountain range and its eastern spurs stretching as far as the region of Kashgar. On the Russian map of Ferghana (Sheet 7) the most exact representation of this mountain region, the name Alai ridge is applied to a high mountain chain running from west to east, and reaching to Terek Davan (c. 73° 30′ E. long.). From this point the direction of the principal chain changes, and, after the Beleuli pass, assumes a northern and north-eastern direction to Aiu-Tapam. These parts bear the name of Baksu Beleuli, and in 72° 45′ E. long. there branches on the north from the chief Alai range a chain with high summits which runs parallel to the north-eastern ridge of the Alai. The great Alai valley belonging to the basin of the Amu Daria divides these Alai ranges from the equally east-and-west running ridge of the Trans-Alai, the eastern continuation of which is found in Mustag-tau. The geological structure on the road between Osh and Kashgar corresponded to the configuration. The strata ran in west-to-east and north-to-south directions. The latter dominated the ancient rocks, clay slates, phyllites, and Palæozoic sediments, which occurred from Gulcha to the neighbourhood of Irkeshtam, and usually showed a high or even vertical dip. These north-and-south running bands showed only a slight western extension. A much consolidated limestone and marl also occurred, and from the fossils they contained they belong to the younger Mesozoic or older Tertiary formation. Between Gulcha and Sufi Kurghan, as well as near Irkeshtam, these rocks appear strongly folded and tilted with a north-and-south strike. In the mountains east of Irkeshtam most of the sedimentary rocks belong to the younger formations, probably only of Tertiary age. They are sandstones with gypsum and coarse conglomerates of enormous thickness, and without exception they have an east-to-west strike. In the ancient rocks of the higher mountains the strata also exhibit a north-and-south strike; they are much folded and show a dark brittle limestone, which is to be found eastward from Irkeshtam to a small pass west of Eghin with the same strike and vertical dip. Recent sandstones with a strike running west-south-west and east-north-east occur quite near. It follows from this observation that the folding of the ancient part of the mountains (schist, Palæozoic rocks, and perhaps also late Mesozoic formations) occurred in one or probably several phases. One folding and compression took a north-and-south direction; but a criterion is wanting as to whether the disturbing forces acted from the east or from the west. A second and later period of folding, which acted almost exactly at right angles to the first,

ridged up the more recent limestones, sandstones, and conglomerates, the strike of which is from east to west. It is noteworthy that traces of these directions of folding also occur in the western part of the mountains, but outside of the crystalline zone. Thus, for example, the great conglomerates in the mountains north of Gulcha have an east-to-west strike, while further west, at Kaplan-Kulit, they run quite normally almost from north to south. Between Gulcha and Sufi-Kurghan two great granite masses are cut through by the Gulcha river in deep, narrow, picturesque gorges; between the granite the highly tilted phyllite shows a splendid contact-metamorphosis into a sort of calcium silicate hornstone, the granite at the same time showing traces of foliation and mechanical alteration. True gneisses, micaschists, or other fundamental formations are never found, not even as river pebbles. On the contrary, phyllitic rocks and altered sedimentary strata take a great place. Palæozoic limestones with fossils of an age not yet exactly determined (corals, crinoids and brachiopods) were found on the east side of the Terek Davan, near Koksu. Fossils with a great predominance of *Ostrea* in a formation apparently belonging to the Upper Cretaceous, were found abundantly near Kizil-Kurghan between Gulcha and Sufi-Kurghan, near Gulcha itself in Irkeshtam, and to the east of that place. Old river terraces are splendidly developed everywhere in the mountains. Traces of them are found high up on the valley walls, and especially in the east several perfect terraces may be seen rising one above another at different levels. At the junction of tributary valleys with the main valleys there are fine examples of loess-covered alluvial fans (delta formations) which have been cut through by the stream, and a second or secondary fan formed further down toward the main river. On the borders of the Tarim basin æolian deposits begin to acquire great importance, and in the neighbourhood of Kashgar the efflorescence of Glauber's salt, which covers the ground like snow, bears evidence to the insufficiency of the rainfall. In the remaining part of the journey, proceeding from Kashgar by Aksu, Turfan, and Khami, to the northern border of the Tarim basin, and thence through the Gobi Desert to the central Kwen-lun (Nan Shan mountains), the attention of the expedition will be specially directed to the formation and origin of the different kinds of soil formed from different rocks by the influence of the desert climate and to the formation of salts upon the surface.

Captain Deasy in Central Asia.—A second communication has been received from Captain Deasy (*ante*, p. 544), dated Yarkand, March 2, in which he announces his return to that place after an unsuccessful attempt to ascend the Yarkand river to the west end of Raskam. Owing to a sudden burst of hot weather, the ice on the river broke up fully a month earlier than usual, and he was compelled to give up the attempt. He is able to state, however, that the true course of the stream from about 37° N., 75° 56′ E., is northerly to Langar (37° 41′ N., 76° 14′ E. approximately), and thence almost due north to Kosarab, about three-quarters of a mile west of which it makes a sharp bend to the east. This agrees on the whole with the earlier delineation of the river, previous to Gromchefski's journey, it having been shown even in Shaw's map (1871) as flowing north by Langar to Kosarab, although the longitudes there given are much too far to the east. Captain Deasy visited both Kosarab and Langar, but though within a few miles of the Khandar Dawan, leading to the Mariom Pamir, a heavy fall of snow prevented him from getting his animals across. He was able to get good longitudes by chronometer, his observations being taken with a 6-inch transit theodolite, by Troughton and Sims. The whole country explored since leaving the Taghdumbash Pamir was excessively difficult, consisting of very deep narrow valleys, bounded by barren and precipitous mountains. The Sandal Dawan in particular (not marked on any map) presented almost insurmountable obstacles. Captain Deasy met with great

courtesy on the part of the Chinese officials, but complains of the extreme difficulty of obtaining trustworthy information with regard to the routes. In a postscript, dated March 31, he announces his intention of starting at an early date to examine the ruins in the Takla Makan, after accomplishing which he hopes to do some exploring in hitherto unvisited regions.

Lake Gokcha.—Prof. T. McKenny Hughes describes in *Nature*, vol. 57 (1898), p. 392, part of his recent journey in Russian Armenia, and in particular his observations on the geology of the country round the Gokcha lake. The situation of this great lake is remarkable; it lies along the edge of the Armenian tableland, over 6000 feet above sea-level, for 43 miles in length, and its breadth in some places exceeds 20 miles. The valley of the Araxes lies far below it, and the lake appears to be barred in by moraine-like ridges. These are not, however, ridges of glacial origin blocking a long narrow valley; but streams of solid lava poured out in front of the steep mountain slope and shutting in against it a basin which has become filled with water and forms the great lake. A narrow stream has cut an outlet at Elenofka, through the more profoundly weathered portion of the lava; but the channel is small, and full even at low water. Prof. Hughes suggests that, when the level of the lake rises, the surplus water escapes by percolation through broken or scoriaceous rocks to other outlets. The maximum depth of Lake Gokcha is usually supposed to be 360 feet, but much remains to be done before the structure and history of the interesting volcanic region of its basin are fully understood.

Expedition of Count Zichy to Central Asia and Siberia.—On March 13 last, Count Eugen Zichy started on an exploring journey, which he has undertaken for the purpose of a thorough investigation regarding the original home and subsequent wanderings of the Magyars, down to their arrival in their present habitation. He will first proceed by way of Tiflis to the country inhabited by the Bashkirs, and the districts south-east of Lake Balkash, in order there to study the remnants of the Hungarian tribes, which, it is thought, reached that region and remained there. He will then continue his journey by way of Omsk and Tomsk to Irkutsk and the districts east and south-east of Lake Baikal, and there make inquiries with regard to the remnants of the Huns dwelling in those parts. Count Zichy, whose energy and determination are well known, will be supported by three scientific experts. One of these, the well-known geographer and ethnologist, Johann Janko, has already carried out preliminary studies in St. Petersburg and Helsingfors; he joined Count Zichy in March at Tiflis. The latter hopes to proceed from Urga across the Gobi to Peking, and thence to Mukden and other Manchurian towns. He thinks it not impossible that he may find there the national records taken from Hungary by Batu Khan in 1241, and carried with him as trophies on his return home in the spring of 1242.

AFRICA.

The Position of Insalah.—M. Foureau, the well-known Saharan explorer, has a note in the *Comptes Rendus* of the Paris Geographical Society, in which he gives his reasons for supposing the longitude of Insalah to be given on our maps far to the west of its true position. The question is important, as on the position of this point the whole of the cartography of Tuat and the neighbouring region has been based. Astronomical observations were supposed to have been made there by Major Laing in 1825, and his assumed position was used by map-makers for over half a century. His notes, however, were never published, and a strange discrepancy is noticeable in the statements as to his longitude of Insalah, a writer in the *Quarterly Review* (vol. 38, 1828) giving it as 2° 15′ E. of Greenwich, while Jomard was informed by General Sabine that Laing had found it to be in 1° 51′ E.

In any case, great dependence could not be placed on Laing's result, as his instruments are known to have been damaged during his journey. Hassenstein, in his memoir on his map of Rohlfs' journey (*Petermanns Mitteilungen*, 1866), discusses the position of Insalah, and is inclined to place it in long. 2° 10′ E., or 5′ W. of Laing's position as given in the *Quarterly Review*, while he gives the probable latitude as 27½° N., or 19′ to the north of Laing's position. M. Foureau has held for some years that the true longitude was about 2° 43′ E. of Greenwich, or 28′ E. of the most easterly position hitherto assigned to the place. He now shows that the astronomical determinations by M. Flamand during his mission to Gurara in 1896 support his view, by showing that other places in the same region must be shifted between 22′ and 38′ to the east, a result corroborated by the itineraries of other officers in the same country. The same number of the *Comptes Rendus* contains a list of M. Foureau's own astronomical determinations of positions, made during his journey of last summer to the country of the Tuareg. His attempt to penetrate further southward was then frustrated merely through want of means to pay the Tuareg for their co-operation. A strong party well supplied should, he thinks, have no difficulty in crossing the Sahara (*Comptes Rendus*, Paris G.S., 1897, p. 350).

Mr. Silva White's Journey to the Siwa Oasis.—Mr. A. Silva White has lately made a bold but unsuccessful attempt to reach the oasis of Jarabub, the stronghold of the powerful Senussi sect of Mohammedans, situated beyond the Siwa oasis, on the line of depression which runs between Egypt and Tripoli parallel to the shore of the Mediterranean. No European seems to have yet visited the oasis, although Rohlfs in 1869 passed within a short distance of it, and was subsequently told that he would have been well received there. Of late years it has been entirely closed to Europeans owing to the fanaticism of its inhabitants. Mr. White started from Cairo with seven attendants, not one of whom was aware of the intended destination. Siwa was reached in nineteen days, and Mr. White was cordially received by the Egyptian governor and the chief headmen, but the Senussi Skeikhs, whose duty it is to prevent Europeans from proceeding westwards towards Tripoli, informed him that his life would be in danger if he persisted in his endeavour. His men, with one exception, refusing to proceed, Mr. White was compelled to relinquish the idea. He stayed some days at Siwa, however, and was able to explore parts of the oasis not previously seen by Europeans, taking a large number of photographs, and bringing away copies of hieroglyphs dating from 1200 B.C.

The Basikunu District, west of Timbuktu.—M. Vuillot contributes to the *Comptes Rendus* of the Paris Geographical Society (1898, No. 2), and to the *Bulletin de l'Afrique Française* (March), notes on the region west of Timbuktu lately traversed by French officers, accompanied by sketch-maps; that in the latter periodical being on the scale of 1:1,000,000. Basikunu, which was temporarily occupied by the French in 1897, lies on the borders of the Sahara in about 16° N. and 5½° E., or about 200 miles west-south-west of Timbuktu. The various routes leading to it from the Niger, Lake Faguibini, etc., as well as those leading north across the Sahara, are shown in M. Vuillot's map. Those from the former direction are well provided with water, and although the direct route north to the Saharan town of Walata is waterless, wells are found on a route *viâ* Neme bending slightly to the west. The subterranean layer of water is at a much smaller depth in this direction than it is to the east of Basikunu. The country generally is thickly covered with acacias and mimosas, and supports large flocks of sheep and goats. Around the towns there are immense fields of corn (millet, wheat, barley, etc.), the environs of Basikunu being exceptionally fertile; while Neme is surrounded by luxuriant groves of date palms. Basikunu occupies a very

important position from its command of trade routes, and M. Vuillot urges the importance of its occupation by France as a preliminary to that of Walata and Arauan.

M. Dubois in the Bend of the Niger.—We learn from the *Revue Française* for April, that M. Félix Dubois, author of 'Tombouctou la Mysterieuse,' returned in March from an exploring journey in the French Sudan. He is said to have crossed the country within the bend of the Niger from the Upper river to Say, and thence to have made his way to Dahome, visiting Mossi and Gurma *en route*. By this land-journey he will have supplemented the results of the river-journeys of Toutée and Hourst.

The Uganda Railway.—The time and fare table for the section of the Uganda railway now open for public traffic, is published in the *Zanzibar Gazette*, having come into force on April 2. First, second, and third-class passengers are booked between any stations as far as Voi, a little north of the Ndara hills, and just 100 miles from the coast. In this distance there are nine stations, in addition to the termini. Each day (except Sundays) the train makes the journey in one direction, returning the following day, so that the service consists of three trains a week in each direction. Starting from Kilindini (the port of Mombasa) at 7.20 a.m., the train reaches Voi at 4 p.m. (or 16^{h} according to the timing employed). Thus, in the space of little over eight hours, a distance is traversed which, in the days of caravans, represented an arduous march of several days, including the passage of the waterless Taru desert, and there can be no doubt that even this comparatively small section will prove of immense advantage as a means of access to the interior. Voi is, according to the railway survey map, at a height of 1650 feet above the sea. The fares from Kilindini to Voi are respectively Rs. 38, Rs. 19, and Rs. 3 as. 3, or roughly 6*d*., 3*d*., and ½*d*. per mile, for the three classes.

Major Gibbons' New Expedition.—Major Gibbons, whose excellent surveying work in the region of the Upper Zambezi is well known to our readers, has just completed his preparations for a new expedition to the same part of South Africa, on which he will be accompanied by six Europeans, including a mineralogist, an ornithologist, and a taxidermist. He hopes to ascend the Zambezi from its mouth to 15° S. lat., and there take up his surveying work, which he will continue if possible to the sources of the river, returning either by the Congo or by Lake Tanganyika and Uganda. The journey is expected to last fifteen months.

English Expedition to Lake Rukwa.—Following on the German expeditions to Lake Rukwa, lately noticed in our pages, comes the news of a journey by an Englishman, Mr. Wallace, which seems to have cleared up the doubt as to the present extent of the lake. A short account of the journey, derived from a letter written by Mr. Wallace from Ujiji, appears in the *Deutsche Kolonialblatt* for April 1. The English traveller appears to have made the complete circuit of the lake, which he reached by following down the Saisi to its mouth, afterwards passing round the south end and up the north-east shore. In lat. 7° 40′ S., he crossed the plain to the south-west side, and proceeded down that side to the Saisi mouth once more. He then made his way to Abercorn, at the south of Tanganyika. Mr. Wallace found open water for a distance of 25 geographical miles only from north-west to south-east, the greatest breadth being 12 geographical miles. The lake lies at the south-east corner of a wide plain, varying from 20 to 30 geographical miles in breadth. Beyond the open water, in a north-westerly direction, a narrow, by no means deep, swamp extends for 30 miles along the north-east margin of the plain, and is followed by a bare, muddy flat, 20 miles long, dry at the time of Mr. Wallace's visit. The Saisi and Songwe streams, which enter Rukwa in the south,

are of about equal size. Along the north-east side there were few stream-beds, all of them dry. The Kafna and Lunga (? Katuma and Rungwa) appear also to dry up before reaching the plain. There is a fair population on both sides of the lake, but water is scarce and bad; game, of two or three kinds only, was everywhere abundant. Mr. Wallace thinks that in the wet season the lake may have a length of 75 to 80 geographical miles, with an average breadth of 15 or 16 miles, and a depth of 3 to 5 feet.

Rock-painting in Manicaland.—Mr. Harry Good writes that, while exploring the geology of Mount Melinjio (about 6000 feet), situated to the west of Umtali, he came upon a rock-painting near the summit, evidently of great antiquity. It represents two elephants and another animal, too indistinct to recognize. A small spring of water hidden by rocks was discovered in the direction the animals were shown to be making for, and the writer believes that the object of the picture may have been to show the way to the water, as the stream did not reappear lower down the mountain. The figures are drawn in good proportion, and are coloured of a reddish-brown tint. No information respecting the picture could be obtained from the natives.

The Anglo-Abyssinian Boundary.—We regret that, owing to a mistake as to the locality of Mount Egu, the new frontier of British Somaliland is incorrectly shown on our map given on p. 293 of the present volume of the *Journal*. The mistake arose through the confusion of the halting-place Egu, a few miles north of Harar, with the "Mount Egu," which, with the mountains of Sau, is mentioned in the treaty as determining the frontier beyond Somadu. These names appear on few of the existing maps, but both may be found on the "Carta dimostrativa dell' Etiopia," in eight sheets, compiled by Captain E. de Chaurand for the Italian War Office in 1894. Both lie roughly in a straight line with Somadu and Moga Medir, so that the whole south-western angle of the British Protectorate, as shown on our map, has now to be cut off.

AMERICA.

Dr. O. Nordenskiöld's Expedition to Alaska.—Dr. Otto Nordenskiöld, the leader of the late Swedish Expedition to Patagonia, has started on an expedition to Alaska, for the purpose of geological exploration in that country and the neighbouring British territory around Klondike. Two assistants will accompany him, and the collection of ethnographical objects forms part of the programme.

Boundary Line between Idaho and Montana.—The following particulars regarding the determination of the boundary line between Idaho and Montana appear in a recent number of the *Bulletin* of the American Geographical Society. In the Sundry Civil Bill, approved June 4, 1897, an appropriation was made for surveying the boundary line between Idaho and Montana, beginning at the intersection of the 39th meridian west from Washington (or 116° 3′ 0″·60 west from Greenwich), with the boundary line between the United States and the British possessions, then following this 39th meridian south until it reaches the summit of the Bitter Root mountains, this line being in all about 70 miles in length. It lies within some of the wildest and least known portions of the United States, and crosses a number of large rivers. In locating the position of the 39th meridian a base was taken in the vicinity of the city of Spokane, Washington; from known points here triangulation was continued westward to the summits of the Bitter Root Mountains, and thence in a belt having a general northerly and southerly position, certain points being determined near the designated meridian. A sufficient number of points have been fixed, so that it will be practicable during the season of 1898 to locate positions for the monuments marking the meridian. Temporary

marks are to be established on preliminary or random lines, and when the true line has been determined monuments will be erected. Distances along the line are to be measured by chaining, or by stadia, where the slopes are so precipitous that they cannot be crossed. The photographs taken along the course of this boundary exhibit a country of extraordinary roughness and complication of structure.

The Modern Mississippi Problem.—Mr. W. J. McGee discusses the history and present position of the study of the greatest river of North America in the *National Geographic Magazine*, vol. ix. (1898) p. 24. He points out that the earlier inquiries turned mainly on the utilization of the river as a means of transportation. Steam navigation began in 1811, and speedily led to the development of the country bordering the river, and the establishment of numerous great towns on its banks. But a third of the towns were in time deserted by the ever-changing channels of the mighty river, a quarter were invaded by the current, and only a third or a quarter were reached by the railways which had grown into the successful rivals of the river in carrying traffic. The railway has conquered. The only remaining river-towns are those which form good railway centres; the palatial passenger steamers, once the finest in the world, have disappeared, and the current of traffic on the river has sunk to one-half or less. At the present time the engrossing problem of the Mississippi is how to preserve the immensely fertile flat plains bordering the river from devastation by the stream itself. When these bottom-lands began to be utilized the natural *levees* or banks of the river were raised artificially to reduce the risk of floods; but this has only rendered the effects of a flood more disastrous when it takes place. Consequently, the Weather Bureau of the United States has established a special service for the study of flood-phenomena, and the prediction of their occurrence.

AUSTRALASIA AND OCEANIC ISLANDS.

Rusden's 'History of Australia.'—Mr. G. W. Rusden has issued a new edition of his 'History of Australia,'* first published in 1883. A preliminary account is given of the history of the discovery of Australia, of its physical geography, and native tribes. This is followed by the detailed history of Australian colonization from the landing of Governor Phillip and the founding of Sydney in 1788 down to 1897. The history of exploration in the interior of Australia is fully treated, and the resources of the continent, both natural and derived, are discussed in a thorough manner. A series of statistical tables are supplied, comparing the resources and present conditions of the several colonies, and the text of a draft bill for creating a Commonwealth of Australia is given as an appendix. There is a full index admitting of easy reference to all the subjects treated in the work.

The Gladstone Colony in Queensland.—The history of the town of Gladstone,† in Queensland, affords some interesting reminiscences of an almost forgotten colonial experiment. Gladstone is situated on the fine bay of Port Curtis in 24° S., south of the mouth of Fitzroy river, and the site of the landing of the Spanish navigator, De Quiros, in 1606, according to Cardinal Moran, Archbishop of Sydney. In 1846 Mr. Gladstone formulated the proposal of establishing a new colony, to be called North Australia, to which convicts might be sent under special restrictions, after public opinion in Sydney had stopped transportation to New South Wales.

* 'History of Australia,' by G. W. Rusden. 3 vols. Melbourne: Melville, Mullen, and Slade, 1897.

† 'The Gladstone Colony, an unwritten chapter of Australian History,' by James Francis Hogan, M.P. London: T. Fisher Unwin, 1898.

On January 30, 1847, the colony of North Australia was duly proclaimed at Port Curtis by Colonel Barney; but in the next year a change of government at home led to the abandonment of the project, and the decree was rescinded. The settlement, however, remained, and grew by the immigration of free settlers. When the colony of Queensland was ultimately established, Gladstone was a serious rival to Brisbane as the site of the capital. In 1858 the discovery of gold caused a rush of diggers, and Gladstone was the Dawson City of the hour; but in a few months thousands left again hopeless of success. Rockhampton became the centre of the gold-fields, when, some years later, they were found to be really of great value; but its possession of the best harbour in Australia, next to Sydney, enabled Gladstone to recover from the damage done by the gold rush, and the approaching completion of the railway from Brisbane will place it in an exceedingly favourable position for further growth.

Irrigation of the Mallee District in Victoria.—Several schemes have lately been set on foot for carrying water into the arid district known as the Mallee, situated to the south of the Murray river near its confluence with the Murrumbidgee, for which no artesian supply can be obtained. Details regarding these were given in the *Melbourne Argus* for December 13, 1897, whilst the most recent developments of the question are recorded in the same journal, in its issue of February 7. It had been pointed out by Mr. Melville that Sea lake and Lake Tyrell in the Mallee are below the flood-level of the Murray at Swan Hill, and, in order to test the feasibility of the scheme proposed by him, the Victorian Government commissioned Mr. Cecchi, of the Water Supply Department, to fully investigate the matter. He is said to have endorsed Mr. Melville's views, and to have found that the flood-waters of the Murray could be carried by gravitation to the portions of the Mallee for which a supply is still needed, without any need for pumping. Improvements on the existing works on the Avoca and Avon rivers are also contemplated, whilst a proposal to form a large storage basin at Lake Lonsdale, in the Grampians, is said to have been approved by the Minister of Water Supply. The *Argus* gives a sketch-map showing the Mallee lands which have, so far, been made available for cultivation.

Clipperton Atoll.—Two communications have recently been read before the Geological Society on Clipperton atoll—the first by Rear-Admiral Sir W. J. Wharton, and the second by Mr. J. J. H. Teall. This atoll, situated in the Pacific in lat. 10° 17′ N., long. 109° 13′ W., possesses a lagoon which is now completely cut off from the sea. In this is a perfectly round hole, where soundings of 20 fathoms or more are reported. On the coral ring there rises a mass of modified trachyte—the subject of the second communication—about 60 feet in height. In Sir Wm. Wharton's opinion, the great depth of the lagoon and the rock-mass on the ring are not compatible with the origin of the reef by subsidence or outward growth; and the possible hypothesis is put forth that this reef had grown on the lip of a volcanic crater or on an island, such as Krakatao, in which the interior has been enlarged and deepened by volcanic explosion. In the discussion, Prof. Clowes stated that, from a chemical standpoint, Mr. Teall had fully proved an extremely interesting case of chemical metamorphosis. Dr. Blanford did not agree with Admiral Wharton that the facts as stated are incompatible with subsidence. He pointed out that neither a volcanic crater with a distinct rim, nor a lava-flow, such as the phosphatized trachyte appeared to have been originally, could be of submarine origin; nor was it probable that either originated on a level with the surface of the sea. In his opinion it was more likely that both crater-rim and lava were formed above the sea, and had been depressed. Sir A. Geikie could see no reason why a volcanic crater should not be formed below the surface of the sea;

but the Clipperton crater may have been of the same explosive origin as that of Santorin, and its solitary rocky peak may be the only remaining visible fragment of its rim. With regard to the supposed impossibility of lavas having flowed under the sea, he observed that no facts in the geological history of Britain were more abundantly proved than that from the earliest Palæozoic periods the vast majority of the volcanic eruptions in our region have been submarine, and that they have included the outflow of lava, the solid, unbroken sheets of which are now found intercalated between strata full of marine organisms.

Ethnographic Investigations in Sumatra.—Dr. Volz, of Breslau, who is engaged in geological and ethnological investigations in Sumatra, has lately (February, 1898), in company with Herr von Autenrieth, made a journey through the Batak country in the northern part of the island, on the shores of Lake Toba. These travellers are the first who have succeeded in penetrating into the district of the Pakpak tribes, who are still cannibals. They returned to Medan, near Deli, after a successful journey, during which large ethnographical collections were made.

POLAR REGIONS.

Danish Arctic Voyages—Early Chart of North Atlantic.—A valuable addition to the literature of Arctic discovery has been made through the publication, by the Hakluyt Society, of a series of accounts of Danish expeditions to Greenland and Hudson bay in the early years of the seventeenth century.* The Society had already issued new editions of all the accounts of early English Arctic voyages, undertaken between 1576 and 1632, and the volumes now before us may be said to complete the series as far as concerns voyages to the north-west within the period in question. The three first voyages treated of are those sent from Denmark in 1605–6–7, in search of the lost colonies in Greenland, in all of which the Englishman, James Hall, took part as pilot. To these is added the account of Hall's own voyage of 1612, undertaken for commercial purposes to the scene of his former labours, as, although this was purely an English enterprise, it helps to throw light on the earlier voyages, supplementing the discoveries made in them. Accounts of three of the Greenland voyages appeared in Purchas and Churchill, and these are reprinted; but a valuable addition to the previously printed material is the publication for the first time of another account by Hall of the voyage of 1605, from a manuscript in the British Museum, with maps, drawn by the pilot himself. Translations of two Danish accounts of the two first voyages are also given, as well as a facsimile of an old chart existing at Stockholm, which evidently belongs to the period in question. The last voyage described in this collection is that of Jens Munk to Hudson bay in 1619–20, which was likewise piloted by Englishmen, and intended to follow up the results obtained by English voyages in search of a North-West passage. The present account is a translation of the 1624 edition of Munk's *Navigatio Septentrionalis*, corrected by the help of his original manuscript. The name of Mr. C. C. A. Gosch appears on the title-page as responsible editor, Mr. Miller Christy, to whose initiative the publication is due, having retired from participation in the editorship before the completion of the work. A certain number of the notes, together with one of the appendices and a chapter of the introduction to Munk's voyage, are, however, by the latter gentleman. In the appendix referred to, Mr. Christy discusses in an exhaustive way the mysterious Buss island, supposed to have been discovered by one of Frobisher's vessels in 1578, and subsequently believed to have sunk beneath the waves. He considers it probable

* 'Danish Arctic Expeditions, 1605 to 1620,' in two books. Edited, with Notes and Introductions, by C. C. A. Gosch. London: Printed for the Hakluyt Society, 1897.

that land was really seen, and that it was part of South Greenland. The other appendix, by Mr. Gosch, treats of the Stockholm chart above alluded to, the conclusion arrived at being that it is a copy of another chart, probably executed by Hall during his stay in Denmark from 1605 to 1607, or perhaps a little later. The names on the copy, several of which are misspelt, were, Mr. Gosch thinks, not given in the original. Mr. Christy does not accept Mr. Gosch's conclusions, but has published a pamphlet, giving his own views on the subject, the principal divergence being that he believes the chart to have been drawn before 1605, possibly to serve as a guide during the voyage of that year, and that the names were added after his return.

Proposed German Arctic Expedition.—We learn from the *Verhandlungen* of the Berlin Geographical Society, that a German arctic expedition has been set on foot for the coming summer. Its object is mainly zoological, but cartographical work and meteorological and other observations will be undertaken. Its leader is Theodor Lerner, who will be supported by various scientific workers, while the ship will be under the command of Captain Rüdiger. The steamer *Helgoland* has been chartered, and, in pursuance of the plan already formed, the expedition started in May from Bremerhaven for Tromsö, where the services of Norwegian ice-pilots and harpooners will be secured; proceeding then to Spitsbergen, of which first the east side, then the west and north, are to be examined. Jan Mayen and the Greenland sea having been visited, the ship will, it is planned, return to Tromsö in August, and thence set out again for Novaya Zemlya and, if possible, Franz Josef Land. It is proposed to return *viâ* East Spitsbergen, where an endeavour will he made to effect an accurate survey of Kong Karl islands. In the most northern parts reached inquiries as to the fate of Andrée's expedition will be made.

Andrée Search Expedition.—It is announced that the Swedish Anthropological and Geographical Society has set on foot an expedition to Siberia for the purpose of searching for the members of Andrée's expedition, or obtaining information which may throw light on their fate. Herr J. Stadling, who accompanied Andrée to Spitsbergen in 1896, has been appointed leader, and was to start from Stockholm early in April.

MATHEMATICAL AND PHYSICAL GEOGRAPHY.

The German Deep-sea Expedition.—We have already mentioned (*ante*, p. 302), the general outline of the programme for the deep-sea expedition about to be despatched by the German Government under the leadership of Prof. Chun. Further details as to the tasks to be undertaken, and the probable plan of the expedition are supplied by Dr. G. Schott, in a paper read before the Berlin Geographical Society in March last (*Verhandlungen*, 1898, Nos. 2 and 3). Dr. Schott divides the objects of the expedition into two groups, the oceanographical and the zoological, devoting greater attention to the former, as of more interest from a geographical point of view. Soundings, for the purpose of determining the form of the ocean floor, form, of course, one of the primary tasks, and for this purpose the Sigsbee machine with some improvements will be employed. A large part of the voyage will lead over still entirely unknown depths, and important results may be expected, both in the South Atlantic, and still more in the Indian ocean. Two areas in particular await exploration here, the one lying east of the Cape of Good Hope, and extending towards the outliers of the Antarctic plateau, the other occupying the wide space between Madagascar in the west, and Sumatra and Australia in the east. In the second of these, over a space little smaller than the whole of South America, only twenty soundings have hitherto been obtained. Great surprises may await us here, in view of the sudden precipitous slopes which

do undoubtedly exist in the depths of the sea. Soundings are also much needed in the neighbourhood of the Seychelles, Chagos islands, etc., in order to prove whether or not these form isolated groups rising from great depths. The chemical constitution and temperature of the water will also be investigated, and as regards the latter the plan of action will differ from that of former expeditions, in that it is considered advisable, owing to the general uniformity which is known to exist in the deeper water, to restrict operations as a rule to the upper layers, to a depth of 2000 to 3000 fathoms, and to the determination of the bottom temperatures. The fact that in the North Atlantic and Pacific, owing to the influence of currents the temperature at 1000 fathoms depth is generally warmer in 30° to 40° of latitude than at the equator, will render an examination of the Indian ocean in this respect of special interest. The reversible thermometer supplied by Negretti and Zambra will be employed by the expedition, but it is hoped that experiments will also be made with Prof. Eschenhagen's telethermometer, which allows of determinations at a distance by means of electricity. As regards the determination of currents, it will be impossible, considering the size of the ship, to adopt Captain Pillsbury's method of anchoring in order to take their direction and speed; the old method, by comparison of the log and astronomical reckonings, must be employed. Other subjects of study will be the dimensions of ocean waves, the colour and transparency of the water, while the thorough investigation of marine life—the primary object of the expedition—will of course be undertaken. Dr. Schott sketches the probable route of the expedition, premising that the general idea will be a cursory examination of the North Atlantic for the purpose of practising the observers; a more detailed study of the east half of the South Atlantic, and a still more careful exploration of the Southern and Central Indian ocean.

Broadening of Atolls.—Mr. Charles Hedley, who took part in the successful coral-boring expedition to Funafuti, gives a short paper in *Natural Science*, xii. (1898) p. 174, on the manner in which coral atolls increase in breadth. The islets of which atolls are usually composed have been shown by recent observers, especially by Dr. Guppy, to be increasing in breadth, although remaining of the same altitude. At the windward corner of an atoll parallel lines of shingle beaches are usually found. As these beaches appear to be due each to a single storm they are termed hurricane-beaches, and they may be used to supply some approximation to a chronological system for measuring the rate of growth of coral formations. If this process were to go on, the submarine reef-flat would in time be entirely built up into land, and as this does not happen it is apparent that the reef-flat itself is being extended seaward. The existence of channels or even caverns in the reef-flat is an indication that the outward growth is brought about by the building out of a talus of coral *débris*. It appears incredible that these channels and caverns can be excavated by the action of the sea on so homogeneous a substance as coral rock.

CORRESPONDENCE.

The New Division of Time and Angles proposed by M. Sarrauton.

For nearly a year the metric system has been legal in England, and before long it will be adopted and appreciated as it deserves. Still, the metric system is yet incomplete. For the measurement of time and angles the ancient sexagesimal method has been retained, the hour being divided into 60 minutes, the minute into 60 seconds, whilst the same has been done for the angular unit, the degree. Thus, whereas the solution of problems concerned with lengths, areas, volumes, weights,

and values has been simplified to the placing a decimal point in its proper place, angles and time have not shared in the benefit.

A century ago Laplace attempted to introduce a new division of the circle into 400 grades, and of the day into 10 hours; but the public declined to accept these disturbances of deeply rooted custom, which had its origin in the far-off times of the ancient Egyptians and Chaldæans, whose judicious choice of twelve as the basis of subdivision both for the day and year bore witness to a profound knowledge of the theory of numbers.

On the appearance of the metric system, the question of the division of the circle, and the assimilation of measures of time and arc, was at once raised. It was proposed to divide the day—the unit of time—into two periods of 10 hours each, and the hour into one-hundredth and one-thousandth parts; whilst the right angle—the angular unit—was divided likewise into 100 grades, the grade into one-hundredth and one-thousandth parts, the ratio between the units being as 1 to 20. The public, however, could not make up its mind to change its ancient unit.

I should not refer to this system, were it not that it has been brought forward anew with very slight modifications of detail. The public would not accept the reform now, any more than a century ago, and it is, moreover, in no way indispensable. The true unit of time in common use is the hour; that of arc is neither the circumference nor even the right angle, but the degree. We say that an angle contains 32°, 76°, but we never employ in calculations arcs of $65\frac{2}{3}$ circumferences.

It is, therefore, only the hour and the degree which there is any need to decimalize, for but slight would be the advantages of decimalizing a unit which is not employed, such as the circumference, or one which is employed only in its fractional parts. We make use of the day and half-day, but have no need to divide it further; whereas in the case of the hour, this is not enough, but we require to measure time down to the minute, or even second. The subdivision, and consequently the decimalization, of the hour is therefore a necessity. So far from being an approach to the decimal day, our system of the decimal hour is positively hostile to it.

It is in astronomy chiefly that the inconvenience of the present system makes itself felt, long calculations being necessary for the comparison of time and angles. Two kinds, both of latitudes and longitudes, have to be employed. The sailor, who reads measures of arc on his sextant and of time on his watch, has on this account to employ more complicated tables than would be necessary were the relation between arcs and times more simple. It is the sailor especially who needs simplicity of method, and who therefore suffers the most from the present state of things.

The system here advocated, which has been proposed by M. de Sarrauton, vice-president of the Oran Geographical Society, fulfils the following requirements: (1) The simplification of calculations by the use of decimal subdivision; (2) the complete assimilation of the day to the circle, so as to avoid the necessity of transforming arcs into time, and *vice versâ*; (3) the least possible disturbance of existing habits.

The sun, in its daily revolution, describes a circle, a day, of twenty-four hours. We divide the hour into one-hundredth and ten-thousandth parts, and thus have a decimal minute and second. The circle in its turn is divided into 240 degrees, so that the hour will correspond to 10 degrees, and in order to pass from a number of hours to a number of degrees, it is only necessary to move the decimal point one point to the right, and *vice versâ*. A table of trigonometrical logarithms may be arranged as simply as one of logarithms of numbers, the arcs becoming, under our system, decimal numbers, with no complicated notation of minutes and seconds. It will

be seen at once how great will be the advantage, in the fact that arcs 10,000 or 1000 times as great as a given arc may be written with the *same* figures, the decimal point alone varying. In short, the conception on which the whole system rests is the retention of the advantages of a decimal division, whilst identifying, so to say, the measurement of time and angles. Although it is quite of recent date—it first appeared only two years ago—it has already made its way, in part, at the *Bureau des Longitudes* in Paris, through the adoption there of the decimal hour.

It is probable that the question will shortly receive the attention of international congresses, in order that an authoritative verdict, before which the world in general must bow, may be given. It is for this reason that I have been anxious to bring the system before the English public, in hopes of obtaining its approval. It is England, in fact, which can alone decide the success of the reform, for any attempt in this direction without her concurrence would remain a dead letter, as nautical charts, tables, etc., are almost all constructed according to English ideas and methods.

In order to bring clearly forward the advantages of the new system, it is necessary to have recourse to dry figures, and to show the two notations side by side.

To take a problem such as frequently suggests itself in practice, and one which should be extremely simple. Let it be required to determine the time at Washington when it is $5^h\ 18^m\ 8^s{\cdot}2$ at the island of Ferro, or, according to our system, $5^h\ 30^m\ 22^s{\cdot}8$. The detail of the calculation will be as follows:—

Longitude of Washington	$51^d\ 34\ 00{\cdot}0$
„ „ Ferro	$11^d\ 93\ 27{\cdot}8$
Difference	$39^d\ 40\ 72{\cdot}2$
Time at Ferro	$5^h\ 30\ 22\ 8$
Difference	$3^h\ 94\ 7{\cdot}2$
Time at Washington	$1^h\ 36^m\ 15^s{\cdot}6$

I leave to the reader the pleasure of carrying out the same calculation with sexagesimal figures, merely informing him that he will find the result $1^h\ 21^m\ 41^s{\cdot}6$.

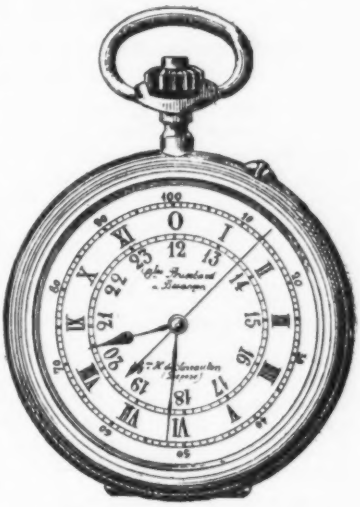
The slightest reflection will show how many conveniences and simplifications will be brought about, in astronomy, from the assimilation of time and angles, a single table serving for both kinds of quantities. But the benefit is not confined to astronomers and navigators, but all questions into which time enters are simplified by the decimalization of the hour. Thus, in measures of speed, there will no longer be any calculation needed to deduce the speed by the minute or second from that by the hour, or *vice versâ*; whilst the inverse problem, the determination of the distance traversed in a given time, is reduced to a simple decimal division.

A decimal watch has been constructed by M. Brisebard, of Besançon, showing the decimal second, *i.e.* the ten-thousandth part of the hour. It ticks the decimal half-second, that is to say, it is possible, if it is in good order, to tell the time within one twenty-thousandth part of an hour. The ordinary time is also shown on the central dial.

The dial is divided into 24 hours, so that, as one hour corresponds exactly to 10 degrees of arc, if the watch is set to the time of the initial meridian, it may serve to determine, *without any calculation*, the longitude of the place in which I may happen to be. In fact, in all points situated in longitude 10 degrees, in the direction of the apparent movement of the sun, that body passes the meridian one

hour after it has done so on the initial meridian; in 26·5 degrees it does so $2^h\ 65^m$ later, and so on. Thus we may formulate the following theorem:—

"At every point of the Earth a decimal watch, set to the time of the meridian zero, marks at mean noon the longitude of that spot; at any other time, the longitude is obtained by a simple subtraction"—slightly more simple and rapid, is it not, than the process necessitated by the employment of the sexagesimal co-ordinates?



I have still a word to say on the question of the universal hour and hour-zones. In our system the question solves itself. The groups of 10 degrees of longitude form naturally the 24 hour-zones into which the circumference of the equator is divided, and which, numbered from 0 to 23, will give the time of all places on the Earth in terms of the initial hour. Thus, the longitude of Washington being 51·34 degrees, *i.e.* $5^h\ 13^m\ 40^s$ as compared with Greenwich, Washington lies in zone No. 5, and the time of this zone will be 5 hours behind that of Greenwich. If, knowing the time of the Washington zone, we wish to know the true time at that city, all that we have to do is to deduct the fractional part of the longitude of Washington expressed in time, *i.e.* $0^h\ 13^m\ 40^s$. If, then, it is $4^h\ 67^m\ 89^s$ Washington universal time, it will be $4^h\ 54^m\ 49^s$ local mean time.

Since October, 1895, when M. Sarrauton first publicly put forward his system, it has received the support of the *Conseils Généraux* of several French departments, and of men like M. Adolphe Carnot, inspector-general of mines; M. Ch. Lallemand, chief mining engineer; and others. The decimal hour has been adopted by the *Bureau des Longitudes*, but it is still not official, as the question must be submitted to an International Congress before receiving a definite solution.

The eminent geographer, M. Elisée Reclus, whose collaborator I have the honour to be, has adopted the decimal division for the globe on the scale of 1: 500,000, the construction of which is at present the object of his study. It will show in a striking way the advantages of a reform from the geographical point of view. M. Lebègue, the eminent Belgian mathematician, is constructing tables of logarithms on the same basis; whilst maps, instruments of mensuration, and chronometers will also soon be in the hands of all who may be desirous of following us in the field of practical application.

The system of the decimal hour and of the circle of 240 degrees has in two years and a half won the suffrages of all who have been willing to rise above questions of opportunism and routine. It is now passing from the domain of theory to that of practice; in a very short space it will, of its own merits, win general recognition.

MAURICE MOREAU MÉRY.

MEETINGS OF THE ROYAL GEOGRAPHICAL SOCIETY, SESSION 1897-1898.

Ordinary Meeting, March 28, 1898.—Sir CLEMENTS MARKHAM, K.C.B., President, in the Chair.

ELECTIONS.—*Percy Hamilton Beechey; F. C. Broadhurst; John Haddock; Donald Hardinge; Godfrey Edward Procter Hertslet; John Massey Leech; Lord Monk-Bretton; Dr. William John Murby; George Bellsworth Piggott; Captain F. C. Quicke (King's Dragoon Guards); William J. G. Reid; T. Fisher Unwin; Frank Whymper; Robert Arna Wood; Right Hon. Earl Percy.*

The Paper read was :—

"Exploration on and around Mount Aconcagua." By E. A. Fitz Gerald.

Ordinary Meeting, April 25, 1898.—General Sir CHARLES W. WILSON, R.E., K.C.B., K.C.M.G., Vice-President, in the Chair.

ELECTIONS.—*H. D. Kyrle-Money Bellew; the Earl of Camperdown; Lieut. Maurice Harvey Clarke, R.N.R.; Frederick Holkham Dangar; J. Buchanan Guthrie; James George Holmes; Percival Henry Ingram; E. A. Locock; John P. Long; John E. Marr, M.A., F.R.S.; Sir William MacGregor, K.C.M.G.; Archibald Sim Montgomery; Harold S. Simmons.*

The Paper read was :—

"Oceanography of the North Atlantic." By H.S.H. the Prince of Monaco.

Afternoon Technical Meeting, Wednesday, April 27, *at* 4.30 *p.m.*—Sir JOHN KIRK, K.C.B., G.C.M.G., in the Chair.

The Paper read was :—

"The Possibility of Acclimatization of Whites in Tropical Countries." By Dr. Sambon.

Ordinary Meeting, May 9, 1898.—LORD BELHAVEN AND STENTON in the Chair.

ELECTIONS.—*Lord Ampthill; Edwin C. Arden; Lieut.-Colonel Alfred E. Bates (United States Army); George Board, B.A. Lond.; George F. Bosworth; Lieut. Claude Russell Brown, R.E.; William Scott Fulton, J.P.; Dr. W. H. Furness; John Alexander Harvie-Brown, F.Z.S., F.R.S.E.; Kenneth Havers; Dr. W. H. Hobson; Charles J. Innes-Baillie, M.A., LL.D.; William Kelly-Patterson, M.D.; Frederick Victor Longstaff; Thomas Arrowsmith Meates; John Cavendish Molson; James Moorhead; Rev. Tom Ferdinand Nicholas, B.A. Oxford; E. de Pentheny-O'Kelly; T. Hilton Renwick; Elkin Salaman; George William Sheldon, M.A., Litt D.; Kunwar Kushal Pal Singh, M.A., LL.B.; Aubrey Strahan, M.A., F.G.S.; Rev. George Ernest Thorn; C. P. Torrens; Charles Rotherham Walker, M.D.; A. P. Watt; Carlen Lacey Weller.*

The Royal and other awards for the present year were announced.

The Paper read was :—

"Journey across Tibet from West to East." By Captain M. S. Wellby, 18th Hussars.

Special Meeting, May 16, 1898.—Sir CLEMENTS MARKHAM, K.C.B., President, in the Chair.

ELECTIONS AT COUNCIL MEETING.—*Ralph Appleton; Theodore Barneby; Lieut. H. E. M. Bourke, R.N. (Retired); G. R. Boyle; Captain F. J. S. Cleave, R.A.; James Charles Getting; Walter Henty; Thomas Mackenzie; Major F. B. McCrea; William J. McG. McCaw; Major E. F. H. McSwiney* (*1st Lancers*); *Lieut. Charles Loughlin O'Malley, R.A.; James Henry Osbourne; Thomas R. Threfall; Alec S. Waley.*

The Paper read was:—

"The Four Hundredth Anniversary of the discovery of the Cape Route to India by Vasco da Gama." By the President.

GEOGRAPHICAL LITERATURE OF THE MONTH.

Additions to the Library.

By HUGH ROBERT MILL, D.Sc., *Librarian*, R.G.S.

THE following abbreviations of nouns and the adjectives derived from them are employed to indicate the source of articles from other publications. Geographical names are in each case written in full:—

A. = Academy, Academie, Akademie.
Ann. = Annals, Annales, Annalen.
B. = Bulletin, Bollettino, Boletim.
Com. = Commerce, Commercial.
C. Rd. = Comptes Rendus.
Erdk. = Erdkunde.
G. = Geography, Geographie, Geografia.
Ges. = Gesellschaft.
I. = Institute, Institution.
Iz. = Izvestiya.
J. = Journal.
M. = Mitteilungen.
Mag. = Magazine.
P. = Proceedings.
R. = Royal.
Rev. = Review, Revue, Revista.
S. = Society, Société, Selskab.
Sitzb. = Sitzungsbericht.
T. = Transactions.
V. = Verein.
Verh. = Verhandlungen.
W. = Wissenschaft, and compounds
Z. = Zeitschrift.
Zap. = Zapiski.

On account of the ambiguity of the words *octavo*, *quarto*, etc., the size of books in the list below is denoted by the length and breadth of the cover in inches to the nearest half-inch. The size of the *Journal* is 10 × 6¼.

EUROPE.

Austria—Cannosa. **Ludwig Salvator.**

Cannosa. Prag: H. Mercy, 1897. Size 13 × 10, pp. vi. and 36. *Plates. Presented by H.I.H. the Archduke Ludwig Salvator of Austria.*

The Archduke Ludwig Salvator continues, in this beautiful little book, his series of monographs on the islands of the Mediterranean, illustrated by wood engravings executed from his own drawings.

Austria—Galicia. *B.S.G. Română* **18** (1897): 110–129. **Burada**

Remășiți românești în Galiția. Conferință de T. T. Burada.

Austria-Hungary.

Publicationen für die Internationale Erdmessung. Die Astronomisch-Geodätischen Arbeiten des K. und K. Militär-Geographischen Institutes in Wien. XI. Band. Astronomische Arbeiten. 3. Längenunterschied-Messungen Sarajevo—Ragusa, Kronstadt—Krakau, Czernowitz—Kronstadt; Polhöhen- und Azimuth-Bestimmungen auf den Stationen Magoshegy, Sághegy und Schöckl. Herausgegeben vom K. und K. Militär-Geographischen Institute. Wien, 1897. Size 12 × 9½, pp. vi. and 284. *Presented by the k.k. militär-geographische Institut.*

Balkan Peninsula. **Weigand.**

Die nationalen Bestrebungen der Balkanvölker. Vortrag gehalten von Dr. Gustav Weigand. Hochschul-Vorträge für Jedermann. Heft ix. Leipzig: Dr. Seele & Co., 1898. Size 9 × 6, pp. 24.

On the Albanians, Greeks, and Slavs of the Balkan peninsula.

Denmark. *B.S.G. Com. Paris* **19** (1897): 807–812. **Castonnet des Fosses.**

Une excursion en Danemark. Le peuple danois. Par M. Castonnet des Fosses.

A short account of a short visit to Denmark.

Europe—Towns. *B.S.G. Com. Bordeaux* **21** (1898): 100–103. **Huni.**

La population de certaines villes d'Europe à 77 ans de distance. Par A. Huni.

A table of the population of eighty-eight towns in Europe in 1820, 1885, 1893, and 1897.

France. *B.S. Topographie France* **21** (1897): 24–32. **Guyot.**

Description topographique et historique du village et de son territoire. Par la Monographie communale. Par M. le capitaine Guyot. *With Map.*

A plea for the preparation of geographical memoirs for the communes and villages of France.

France and England. *Rev. Maritime* **136** (1898): 246–300. **La Roncière.**

Quatrième guerre navale entre la France et l'Angleterre (1335–1341). Par M. Ch. de La Roncière.

France—Assérac. *B.S.G. Com. Saint-Nazaire* **14** (1897): 17–64. **Chiron.**

Monographie de la commune d'Assérac. Par M. Chiron. *With Plates.*

A compendium of facts affording a basis for geographical treatment.

France—Ile de Groix. *B.S.G. Madrid* (1898): 153–162. **Sardá.**

La Escuela de pesca de la isla de Groix (Bretaña). Por D. Agustin Sardá.

France—Mont Blanc. *B.S. Topographie France* **21** (1897): 47–61. **Guyot.**

Annales de l'Observatoire météorologique du Mont-Blanc (altitude 4,358 mètres), publiées sous la direction de M. J. Vallot. Par M. Guyot. *With Illustrations.*

France—Normandy. *B.S. Topographie France* **21** (1897): 5–15. **Filon.**

Le cap Antifer et la carte de l'État-Major. Per M. F. Filon.

This paper appeared also (with maps) in the *Revue de Géographie* for March, 1897.

France—Statistics. ———

Statistique Générale de la France. Tomes XX^ième, XXI. et XXII. Statistique Annuelle (Années, 1890–1891–1892); Tome XXIII. Statistique Annuelle (Année, 1893). Paris: Imp. Nationale, 1895–1896. Size 11 × 7½. *Presented by the French Ministry of Commerce.*

France—Statistics. ———

Annuaire statistique de la France. XVII^e volume. 1837. Paris: Imp. Nationale, 1897. Size 11 × 7½, pp. xxxii. and 522. *Presented by the French Ministry of Commerce.*

France—Time Standard. *Rev. Scientifique* **9** (1898): 491–497. **Lallemand.**

L'heure légale en France et les fuseaux horaires. Par M. Ch. Lallemand.

A discussion of the French time-standard, with the view of showing the advisability of adopting Western European time.

Germany. **Oberhummer.**

Bericht der Central-Kommission für Wissenschaftliche Landeskunde von Deutschland von Ostern 1895 bis Ostern 1897 erstattet vor dem XII. Deutschen Geographentage in Jena vom vorsitzenden der Kommission Prof. Dr. Eugen Oberhummer. Sonder-Abdruck aus den Verhandlungen des XII. Deutschen Geographentages. Berlin, 1897. Size 9½ × 6½, pp. 16. *Presented by the Author.*

Germany—Hamburg. *Questions Diplomat. et Colon.* **1** (1897): 212–219. **Blondel.**

Le port de Hambourg. Par M. Georges Blondel.

A study of the growth of Hamburg as a commercial port.

Iceland. *G. Tidskrift* **14** (1898): 130–149. **Bruun.**

Gjennem affolkede Bygder paa Islands indre Højland. Rejseberetning for 1897 af Kaptajn Daniel Bruun. *With Map and Illustrations.*

Account of a journey through the centre of Iceland in 1897, for the purpose of finding and investigating the ruins of early dwellings.

Iceland—Earthquakes. *G. Tidskrift* **14** (1898): 93–113. **Thoroddsen.**

Jordskjælv i Islands sydlige Lavland, deres geologiske Forhold og Historie. Af Dr. Th. Thoroddsen. *With Map.*

Italy. **Magistris.**

L. F. de Magistris. La depressione prenestina e il passo degli olmi nell' estremo lembo di sud-est della Campagna romana.—Estratto dal "Bollettino della Società Geografica Italiana," serie iii. volume xi. 3. Roma, 1898. Size 9½ × 6, pp. 16. *Presented by the Author.*

Italy—Elba. ———

B.S. Languedoc G. **19** (1896): 291–316, 435–454; **20** (1897): 223–239.

L'île d'Elbe au début du XIX^e^ siècle. Extrait des *Souvenirs* de Pons (de l'Hérault).

Historical notes on the Island of Elba about the time of Napoleon's imprisonment there.

Italy—Herculaneum and Pompeii. **Horne.**

The Buried Cities of Vesuvius: Herculaneum and Pompeii. By John Fletcher Horne, M.D., D.SC. London: Hazell, Watson & Viney, 1895. Size 9 × 6, pp. vi. and 114. *Illustrations. Presented by Dr. Innes-Baillie.*

This sketch of Vesuvius and of the ruins of Herculaneum and Pompeii was designed as a popular lecture. It contains some descriptions of Roman life at the beginning of the Christian era.

Italy—Po Delta. *Rev. G. Italiana* **5** (1898): 24–37, 65–85. **Marinelli.**

L'accrescimento del delta del Po nel secolo XIX. Di G. Marinelli. *With Map.*

This paper will be referred to in a note.

Italy—Sardinia. *Rev. G. Italiana* **5** (1898): 106–126. **Cossu.**

Una ricerca antropo-geografica sull' isola di Sardegna. Distribuzione della popolazione rispetto alla distanza dal mare di Angelo Cossu.

A study of the distribution of the population of Sardinia with reference to the slopes to the four sides of the island, and to distance from the sea.

Italy—Sicily. *Globus* **73** (1898): 169–174, 186–192. **Bergeat.**

Die äolischen Vulkaninseln bei Sicilien. Von Dr. Alfred Bergeat. *With Illustrations.*

Mediterranean—Cyprus. *Globus* **73** (1898): 218–222. **Deschamps.**

E. Deschamps Reise auf Cypern.

Mediterranean—Lampedusa. *Questions Diplomat. et Colon.* **2** (1897): 449–455. **Brunet.**

Un projet de colonisation russe au XVIII^e^. siècle. Par M. Louis Brunet.

Norway. *G.Z.* **4** (1898): 185–202. **Magnus**

Verkehrswege und Verkehrsformen in Norwegen. Von Hagbart Magnus. *With Three Plates.*

On the means of transport in Norway, with pictures of boats, bridges, and roads.

Portugal—Archæology. **Vasconcellos.**

Quarto Centenario do Descobrimento da India. Contribuições da Sociedade de Geographia de Lisboa. Religiões da Lusitania na parte que principalmente se refere a Portugal. Por J. Leite de Vasconcellos. Volume i. Lisboa: Imp. Nacional, 1897. Size 10 × 6½, pp. xl. and 440.

On the prehistoric religions of Portugal, especially in the Neolithic period, with a discussion of the significance of inscribed and cup-marked stones, dolmens, and other early monuments.

Rumania. *B.S.G. Română* **18** (1897): 151–181. **Brun.**

La Roumanie actuelle, les habitants et leurs mœurs, la montagne et la plaine, le Danube et la mer. Par M. Jules Brun.

Rumania. *B.S.G. Româna* **18** (1897): 15–109. **Felix.**

Geografia medicală a României. De Doctor I. Felix.

Russia—Baltic Provinces. *Globus* **72** (1897): 377–384. **Bielenstein.**

Das lettische Wohnhaus in der Mitte des 19. Jahrhunderts. Von Dr. A. Bielenstein. *With Illustrations.*

Russia—Caspian Sea. **Pushchin.**

Caspian-Sea Pilot. Hydrographical description and guide for navigation. By Captain N. Pushchin. Published by the Hydrographical Department, Ministry of Marine. St. Petersburg, 1897. Size 9 × 6, pp. 1–345. *Maps, Illustrations, and Tables.* [In Russian.] *Presented by the Russian Hydrographic Department.*

Russia—Census. *Contemporary Rev.* **72** (1897): 837–845. **Dillon.**

The First Russian Census. By E. J. Dillon.

A brief account of the recent Russian census, and some discussion of its statistics.

Russia—Finland. *Norske G.S. Aarbog* **8**, 1896–97 (1897): 1–21. **Nielsen.**

Prof. dr. Yngvar Nielsen: Valamo i Ladoga.

Russia—Lapland. *Iz. Imp. Russian G.S.* **32** (1897): 411–439. **Sikora.**

Expedition to the sources of the river Muonio (tributary of Tornea) for the observation of the solar eclipse, July 28 (August 9), 1896. By I. I. Sikora. *Map and Illustrations.* [In Russian.]

ASIA.

Asia—Central. *Rev. G.* **41** (1897): 433–440; **42** (1898): 5–13. **Chaffanjon.**

A travers le Turkestan Russe, la Mongolie, la Mandjourie et la Sibérie méridionale. Par J. Chaffanjon.

Asia Minor. *Questions Diplomat. et Colon.* **2** (1897): 11–32. **Avril.**

Les Arméniens indépendants du Taurus. Par le Baron A. d'Avril. *With Map and Illustration.*

Describes the historical relations of the Armenians in Cilicia, Hajin, Sis, Zeitun, most of the space being given to the last named.

Asia Minor—Lydia. **Buresch.**

Aus Lydien, epigraphisch-geographische Reisefrüchte, hinterlassen von Karl Buresch. Herausgegeben von Otto Ribbeck. Leipzig: B. G. Teubner, 1898. Size 10 × 7, pp. xvi. and 226. *Map. Price* 14 *marks. Presented by the Publisher.*

This important work is prefaced by a biography of the author, Karl Buresch, who was born in Hanover in 1862, studied at Marburg, and in 1888 made a journey through Asia Minor, which was followed by a long residence in Greece and Asia Minor, studying the ancient inscriptions, until his death in 1896. A map on the scale of 1 : 500,000 gives the routes of his four chief journeys, three of which are fully described in the text, which contains, besides, a transcript of the inscriptions which he studied, together with his notes upon them.

Asia—Railways. *Deutsche Rundschau G.* **20** (1898): 313–317. **Umlauft.**

Die Eisenbahnen Asiens. Von Friedrich Umlauft. *With Map.*

More than two-thirds of the total length of the railways in Asia are credited to India, and about one-seventh to Russia.

China. *Questions Diplomat. et Colon.* **2** (1897): 513–535, 585–613. **Brenier.**

Rapport général de la mission Lyonnaise d'exploration en Chine. Par M. Henri Brenier.

China. *Fortnightly Rev.* **63** (1898): 664–679. **Hallett.**

British Trade and the Integrity of China. By Holt S. Hallett.

China. *Imp. and Asiatic Quarterly Rev.* **5** (1898): 301–308. **Michie.**

China in Commotion. By A. Michie.

China—Hainan. *Questions Diplomat. et Colon.* **1** (1897): 516–522. **Madrolle.**

Haïnan. La colonisation chinoise; l'île au point de vue économique et diplomatique. Par M. Claudius Madrolle. *With Maps.*

Notes of a visit to Hai-nan in 1896, with a linguistic map of the island.

China—Kiauchou. *Rev. Française* **23** (1898): 213–220. **Fauvel.**

Kiao-tcheou. Par A. A. Fauvel. *With Map.*

China—Mongolia. *Imp. and Asiatic Quarterly Rev.* **5** (1898): 387–400. **Gowan.**

Mongolia, with an Introduction on "The Partition of China." By Lieut.-Colonel W. E. Gowan.

The account of Mongolia is stated to be translated from Lieut. Z. Matusovski's Russian 'Sketch of the Chinese Empire.'

China—Trade. *Questions Diplomat. et Colon.* **2** (1897): 129–143. **Pila.**

La mission lyonnaise d'exploration en Chine et le développement de notre commerce extérieur. Par M. Ulysse Pila.

Discusses the relative shares of the European powers in the foreign trade of China, and describes the important visit paid by a Commercial mission from Lyons during 1895–97 to Yunnan and the south of China.

China—Yangtse. **Mouchez.**

Questions Diplomat. et Colon. **2** (1897): 144–156, 206–210, 259–270.

Souvenirs de Chine. Par C. Mouchez. *With Maps.*

Describes the visit of the French gunboat *Lutin* to the Tong-ting and Poyang lakes on the Yang-tse, and gives an account of the incidents which led to it.

Chinese Empire. *B.S.G. Com. Paris* **19** (1897): 801–806. **Bonin.**

Les grandes voies commerciales de l'Asie centrale. Par M. Ch.-E. Bonin.

On the existing trade-routes of Tibet and Mongolia.

Chinese Turkestan—Lob-Nor. **Kozloff.**

P. K. Kozloff. Lob-Nor. [In Russian.] St. Petersburg: Printed by A. S. Suvorin, 1898. Size 9½ × 6½, pp. 62. *Maps. Presented by the Author.*

M. Kozloff discusses the whole question of Lob-Nor, giving the views of the Chinese historians and geographers, of Prjevalsky, Richthofen, Pyevtsoff, Bogdanovich, and Sven Hedin. The memoir is summarised, *ante*, p. 652.

Eastern Asia. *Quarterly Rev.* **187** (1898): 546–566. ———

Changes in the Unchanging East.

A study, based on recent books, of the changes now in progress in China, Japan, and Korea.

Eastern Asia. **Loureiro.**

Quarto Centenario do Descobrimento da India. Contribuições da Sociedade de Geographia de Lisboa. No oriente. De Napoles á China (Diario de viagem). Por Adolpho Loureiro. 2 vols. Lisboa: Imp. Nacional, 1896–97. Size 10 × 6½, pp. (vol. i.) 370; (vol. ii.) 420.

The diary of an extensive tour in the East, carried out by the author between July, 1883, and August, 1884. He visited Mocão, where he stayed some months, and touched at many ports of China, French Indo-China, and India.

Historical. *J.R. Asiatic S.* (1898): 241–288. **Kennedy.**

The Early Commerce of Babylon with India—700–300 B.C. By J. Kennedy.

French Indo-China. *Questions Diplomat. et Colon.* **1** (1897): 28–31. **Attanoux.**

La navigabilité du Mékong de la Chine au haut Laos. Par M. J. B. d'Attanoux. *With Map.*

On the ascent of the Mekong by the gunboat *La Grandière*, and a sketch-map of the river from Pakta to the Chinese frontier.

French Indo-China. **Fleury-Ravarin.**

Questions Diplomat. et Colon. **1** (1897): 86–91, 133–137.

Ce qu'il faut faire en Indo-Chine. Par M. Fleury-Ravarin.

India—Assam. **Monahan.**

Report on the River-borne Trade of the Province of Assam for the year 1896–97. By F. J. Monahan. Calcutta, 1897. Size 13½ × 8½, pp. iv., 16, and lx. *Map.*

India—Burma. **Bird.**

Wanderings in Burma. By George W. Bird (Educational Department, Burma). Bournemouth: F. J. Bright & Son; London: Simpkin & Co., 1897. Size 11 × 7½, pp. 410. *Maps and Illustrations. Presented by the Author.*

This handsome volume commences with a compilation from various authentic sources descriptive of Burma and its present resources. Most of the book consists of a series of detailed itineraries between the principal places of the province, in the course of which full details are given of the present condition of the country, its historical sites and great buildings. Plans of the towns and temples, numerous fine photographs, and a large-scale map of the province (about 1 : 2 000,000) add greatly to the value of the work, which represents a vast amount of careful and conscientious labour.

India—Burma. *Scottish G. Mag.* **14** (1898): 188–198. **Sutherland.**

Along a Shan Road, Southern Shan States, Upper Burma. By Wm. Sutherland.

A graphic narrative of a journey in Eastern Burma.

India—Palk Strait. *J.R. Asiatic S.* (1898): 377–378. **Ferguson.**

Palk's Bay and Strait. By Donald Ferguson.

On the derivation of the name of Palk strait, which was named after Sir Robert Palk, governor of Madras from 1763 to 1767, but is derived by Egli, on the authority of Schlagintweit, from a Sinhalese word meaning "the whirl." The probable reason of this mistake is suggested.

Indo-China. *Questions Diplomat. et Colon.* **2** (1897): 274–281. ——

Considérations sur les voies de pénétration du Sud de la presqu'île indo-chinoise. Par M. A. V. *With Map.*

Indo-China. **Orleans.**

Prince Henri d'Orléans. Du Tonkin aux Indes, Janvier 1895—Janvier 1896. Illustrations de G. Vuillier. Cartes et Appendice Géographique par Émile Roux. Paris: Calmann Lévy, 1898. Size 12 × 8¼, pp. 442. *Maps and Illustrations. Price* 16*s.*

This work, which differs in some details from the English translation, has been noticed in the *Journal* for May, p. 545.

AFRICA.

Algeria—Sahara. *Rev. G.* **42** (1898): 22–32. **Attanoux.**

L'utilisation du Sahara Français. Par J. Bernard d'Attanoux.

The title scarcely indicates the nature of the contents of this article. The actual condition of the Sahara and its inhabitants is the principal subject of the paper.

Algeria—Sahara. *C. Rd. S.G. Paris* (1898): 68–69. **Oltramare.**

Rapport sur les déterminations astronomiques de latitudes et longitudes, effectuées par M. Foureau dans son voyage de mars à juin 1897. Par F. Oltramare.

British South Africa. *J. United Service I. India* **27** (1898): 26–50. **Baden-Powell.**

The Campaign in Rhodesia. By Lieut.-Colonel R. S. Baden-Powell. *With Diagram.*

British West Africa. *B. Comité l'Afrique Française* **8** (1898): 19–21. ——

La chemin de fer de Sierra-Leone. *With Map.*

The map shows the progress of the Sierra Leone railway up to October 25, 1897.

British West Africa—Benin. *B. Liverpool Museums* **1** (1898): 49–70. **Forbes.**

On a collection of Cast-Metal Work, of high artistic value, from Benin, lately acquired for the Mayer Museum. By the Director of Museums. *With Illustrations.*

British West Africa—Niger Delta. *Blackwood's Mag.* **163** (1898): 451–460. ——

Life and Death in the Niger Delta.

A graphic and painfully realistic account of the darker aspects of commercial enterprise in West Africa, and the conditions in which they are carried on.

Cape Colony. *P.I. Civil Engineers* **130** (1897): 263–275. **Heenan.**

The Harbour of Algoa Bay, Cape Colony. By R. H. H. Heenan. *With Diagrams.*

The sandy beach of Algoa Bay required the construction of a harbour, which has recently been extended and improved, so as to obviate the inconvenience of landing cargo in surf-boats.

Congo State. ——

Société d'Études Coloniales. Manuel du Voyageur et du Résident au Congo. 3 vols. Bruxelles, 1895–1897. Size 9½ × 6¼, pp. (vol. i.) 344; (vol. ii.) 214; (vol. iii.) 428. *Map (in four sheets) and Illustrations. Price* 15 *fr.*

Congo State. *Rev. Scientifique* **9** (1898): 385–390. **Laurent.**

L'agriculture au Congo. Par M. Émile Laurent.

Congo State—Kasaï. *Mouvement G.* **15** (1898): 165–167. **Wauters.**

L'ancienne mer intérieure du Kasaï. Par A. J. Wauters. *With Map.*

Egypt. *Fortnightly Rev.* **63** (1898): 681–699. **Dicey.**

Egypt, 1881–1897. By Edward Dicey, C.B.

On the recent administration of Egypt and its results.

Egypt—Kassala. *Questions Diplomat. et Colon.* **2** (1897) 455–460. **Noll.**

Kassala. Par M. Ned Noll.

French Congo. *B.S.G. l'Est* (1897): 23–42. **Clozel.**

De la Sangha à la Ouôm. Par M. F. J. Clozel. *With Map.*

The Wom is one of the head streams of the Logone flowing into Lake Chad.

French Guinea. *Questions Diplomat. et Colon.* **2** (1898): 465–471. **Maclaud.**

La Guinée Française. Par Dr. Maclaud.

French Guinea. *B. Union G. Nord de la France* **18** (1897): 43–67. **Salesse.**

De Conakry au Niger. Par le Capitaine Salesse. *With Map.*

The survey for a railway from Konakry to Faranna on the Niger in 1896 is here described.

French Sudan. *B. Comité l'Afrique Française* **8** (1898): 96–99. **Vuillot.**

La région de Bassikounou. Par M. P. Vuillot. *With Illustrations and Maps.*

French Sudan—Timbuktu. **Machat.**

Questions Diplomat. et Colon. **1** (1897): 463–468, 522–529.

Tombouctou et la politique française dans l'Afrique du nord-ouest. Par M. J. Machat. *With Map.*

German East Africa. *M. Deutsch. Schutzgeb.* **11** (1898): 87–88. **Prince and Stadlbaur.**

Hauptmann Prince's und Lieutenant Stadlbaur's Reisen im Wakimbulande. Von Dr. Richard Kiepert. *With Map.*

NORTH AMERICA.

Alaska and Bering Strait. **De Windt.**

Through the Gold-Fields of Alaska to Bering Straits. By Harry De Windt. London: Chatto & Windus, 1898. Size 9 × 6, pp. viii. and 312. *Map, Portrait, and Illustrations. Price* 16*s.*

The gold-fields of the Canadian Yukon are described, as well as those of Alaska referred to in the title.

Canada. *American J. Sci.* **5** (1898): 273–282. **Chalmers.**

The Pre-Glacial Decay of Rocks in Eastern Canada. By Robert Chalmers.

Canada. **Dalton.**

Salmon Fishing in Eastern Canada. By Lieut.-Colonel J. C. Dalton. Reprinted from *Proceedings*, Royal Artillery Institution, No. 2, vol. xxv. Woolwich, 1898. Size 10 × 6½, pp. 12. *Map. Presented by the Author.*

Canada—Colonisation. **Anton.**

Questions Diplomat. et Colon. **2** (1898): 355–365, 432–438, 487–495.

Parallèle entre la Colonisation moderne et la Colonisation, sous l'ancien régime. Par Dr. G. K. Anton. Traduit. Par Alexandre Halot.

A study of the results of French and British colonisation in Canada, with a discussion of the future evolution of the Dominion.

Canada—Geology. *J.G.* **6** (1898): 147–160. **Tyrrell.**

The Glaciation of North Central Canada. By J. Burr Tyrrell. *With Maps.*

This paper traces the glaciation of Canada to three glacial systems, consecutive to each other in the order—the Cordilleran glacier, the Keewatin glacier, and the Labradorean glacier.

Canada—Western Ontario. *B. Geolog. S. America* **9** (1898): 223–238. **Coleman.**

Clastic Huronian Rocks of Western Ontario. By Arthur P. Coleman.

Mexico—Palenque. **Maudslay.**

Biologia Centrali-Americana; or, Contributions to the Knowledge of the Fauna and Flora of Mexico and Central America. Edited by F. Ducane Godman and Osbert Salvin. Archæology. By A. P. Maudslay. [Part ix., October, 1897.] (Vol. iv. pp. 27–30.) London: R. H. Porter and Dulau & Co. Size 13 × 10½. *Plates* xlix.–lxxiii. *Separate.* Size 13 × 20½.

The continuation of Mr. Maudslay's fine series of photographs of Central American ruins.

United States. *Scottish G. Mag.* **14** (1898): 169–187. **Gannett.**

The Material Growth and Present Condition of the United States. By Henry Gannett. *With Diagrams and Maps.*

A paper read at the Toronto meeting of the British Association, illustrated by numerous statistical diagrams and outline-maps.

United States. *J. Geology* **6** (1898): 171–181. **Leverett.**

The Weathered Zone (Sangamon) between the Iowan Loess and Illinoian till sheet. By Frank Leverett.

United States—California. **Reinstein.**

Address of Regent J. B. Reinstein at the Special Meeting of the Regents of the University of California "For the purpose of suggesting and discussing matters necessary to the prosperity of the University," January 15, 1898. Size 9½ × 6, pp. 42.

Deals with the functions of a University with relation to the whole life of the State.

United States—Coast and Geodetic Survey.

Report of the Superintendent of the U.S. Coast and Geodetic Survey, showing the Progress of the Work during the Fiscal Year ending with June, 1896. Washington, 1897. Size 12 × 9½, pp. xxiv. and 722. *Maps and Charts. Presented by the Survey.*

This report contains a history of the work of the Coast and Geodetic Survey for 1896, together with a series of appendices dealing with terrestrial magnetism, the resulting heights from spirit-levelling operations in several states, and other geodetic questions. The more important of these appendices are noted separately.

SOUTH AMERICA.

Andes. *Travel* **2** (1898): 551-558. **Whymper.**

Mountaineering outside Europe. I. The Andes. By Edward Whymper. *With Illustrations.*

Argentine Republic. **Gherardo.**

Argentina. Gl' italiani nel distretto consolare di Cordoba. Rapporto del nob. cav. Gherardo dei principi Pio di Savoia, regio console in Cordoba.—Bollettino del Ministero degli Affari Esteri. Febbraio, 1898. Roma, 1898. Size 9½ × 6½, pp. 40.

Argentine Republic. **Moreno.**

Musée de La Plata. Reconnaissance de la Région Andine, de la République Argentine. I. Notes préliminaires sur une Excursion aux territoires du Neuquen, Rio Negro, Chubut et Santa Cruz effectuée par les sections topographique et géologique, sous la direction de Francisco P. Moreno. La Plata, 1898. Size 11½ × 7½, pp. 186. *Map and Plates. Presented by the Author.*

Brazil—Rio Branco. *Deutsche Rundschau G.* **20** (1898): 241-250, 306-313. **Hübner.**

Nach dem Rio Branco. Von Georg Hübner. *With Map and Illustrations.*

AUSTRALASIA AND PACIFIC ISLANDS.

Australasia. *Imp. and Asiatic Quarterly Rev.* **5** (1898): 344-361. **Badenoch.**

Australasia in 1898. (A) Australia, (B) Tasmania, (C) New Zealand. By G. R. Badenoch, LL.D.

Statistical notes of the several colonies, apparently taken from official reports.

Australasian Travel. **Shoemaker.**

Islands of the Southern Seas, Hawaii, Samoa, New Zealand, Tasmania, Australia, and Java. By Michael Myers Shoemaker. New York and London: G. P. Putnam's Sons, 1898. Size 8½ × 6, pp. xiv. and 278. *Map and Illustrations. Price* 10*s.* 6*d.*

The impressions of a tourist with a sense of the picturesqueness of his surroundings.

Australia. **De Winton.**

Soldiering Fifty Years Ago. Australia in "the Forties." By Major De Winton. London: European Mail Limited, 1898. Size 7½ × 5, pp. 192. *Presented by the Author.*

Major de Winton's attractive autobiographical sketch contains some interesting description of life in Australia fifty years ago, when he was with the troops engaged in guarding the convict settlements.

Dutch New Guinea. *Tijds. Ind. Taal-, Land-, en Volk.* **40** (1897): 150-177. **Van der Roest.**

Uit het leven der bevolking van Windessi (Nederl. Nieuw-Guinea). Door J. L. D. van der Roest.

Ellice Group—Zoology. **Hedley.**

Australian Museum, Sydney. Memoir III. The Atoll of Funafuti, Ellice Group: its Zoology, Botany, Ethnology, and General Structure, based on collections made by Mr. Charles Hedley. Part 6. Sydney, 1898. Size 10 × 6½, pp. 349-368. *Presented by the Australian Museum.*

POLAR REGIONS.

Antarctic. *Scottish G. Mag.* **14** (1898): 198–202. ———

Antarctic Exploration.

After some introductory remarks, this paper gives a summary of the proceedings at the Royal Society's Antarctic meeting.

Antarctic. *B.S.G. Italiana* **12** (1898): 209–212. **Faustini.**

Alcune altre osservazioni sulle "Appearances of Land" nella zona polare antarctica. Nota del Socio A. Faustini.

Antarctic. *P.R.S.* **62** (1898): 424–451. **Murray.**

The Scientific Advantages of an Antarctic Expedition. By John Murray, D.SC., etc.

The official record of the meeting which is reported in the *Journal* for April, p. 416. It includes the remarks made by the Duke of Argyll, Sir J. D. Hooker, Dr. G. Neumayer, Sir Clements Markham, Dr. A. Buchan, Sir A. Geikie, and Prof. D'Arcy Thompson, but not those of the other speakers.

Antarctic. **Russell.**

Icebergs in the Southern Ocean, No. 2. By H. C. Russell, B.A., etc. Sydney, 1897. Size 9 × 6, pp. 32. *Map and Diagram.*

Arctic—Danish Expeditions. *G. Tidskrift* **14** (1898): 123–130. **Jensen.**

Danske arktiske Expeditioner 1605–1620. Udgivne med Anmærkninger og Indledninger af C. C. A. Gosch for the Hakluyt Society. Anmeldt af J. A. D. Jensen.

On the Hakluyt Society's recent work on 'Danish Arctic Expeditions, 1605–1620.'

Arctic Exploration. *Wide World Mag.* **1** (1898): 53–62. **Nansen.**

How the North Pole will be Reached. By Fridtjof Nansen. *With Map and Illustrations.*

Arctic Regions. **Weber.**

Münchener geographische Studien, herausgegeben von Siegmund Günther. Viertes Stück: Die Entwickelung der Physikalischen Geographie der Nordpolarländer. Von Dr. Heinrich Weber. München: T. Ackermann, 1898. Size 9½ × 6, pp. 250.

MATHEMATICAL GEOGRAPHY.

Cartography. *B.S. Topographie France* **21** (1897): 42–46. **Perrin.**

Causerie sur les écritures en topographie. Par M. Albert Perrin.

Nautical Almanac. ———

The Nautical Almanac and Astronomical Ephemeris for the year 1901. Also Part I. (Containing such portions as are essential for Navigation.) Published by order of the Lords Commissioners of the Admiralty. London: Eyre & Spottiswoode, [1898]. Size 9 × 6, pp. xiv., 652, and 18; (Part I.) xiv. and 314. *Price* 2*s.* 6*d.* *Part I.* 1*s.* *Presented by the Admiralty.*

Nautical Astronomy. **Marcuse.**

Beiträge zur nautischen Astronomie. (Fortsetzung, Zweiter Theil.) Von Dr. Adolf Marcuse. Sonder-Abdruck aus 'Marine-Rundschau.' 3 Heft, 1898. Size 9½ × 6½, pp. [10]. *Presented by the Author.*

Photographic Surveying. *Nature* **57** (1898): 563–564. ———

Photographic Surveying.

A sketch of recent progress in photographic surveying, with special reference to the use of the Bridges Lee camera.

PHYSICAL AND BIOLOGICAL GEOGRAPHY.

Climate. *Meteorolog. Z.* **15** (1898): 85–105. **Meinardus.**

Ueber einige meteorologische Beziehungen zwischen dem Nordatlantischen Ocean und Europa im Winterhalbjahr. Von Dr. Wilh. Meinardus. *With Diagrams.*

An extension of Prof. Pettersson's important paper on the connection between oceanographical and meteorological conditions.

Land-forms. **Penck.**

Die Erdoberfläche. Bearbeitet von Universitäts-Prof. Dr. Albr. Penck. (Sonder-abdruck aus Scobel, Geographisches Handbuch zu Andrees Handatlas. 2 Auflage, Bielefeld und Leipzig, 1895.) Size 10 × 6½, pp. 34. *Illustrations. Presented by the Author.*

Meteorology. *J. School G.* **2** (1898): 96–104, 139–146. **Jameson.**

Some suggestions for teaching Elementary Meteorology. By J. M. Jameson. *With Illustrations.*

Meteorology and Oceanography. *Meteorolog. Z.* **15** (1898): 16–29. **Zenker.**

Die Winterwinde des nordatlantischen Oceans und die Afrikanischen Antimonsune. Von Dr. W. Zenker.

Meteorology—Aurora. *G. Tidskrift* **14** (1898): 113–116. **Paulsen.**

Nordlys. Af Adam Paulsen.

Meteorology—Rainfall. **Supan.**

Dr. A. Petermanns Mitteilungen. Ergänzungsheft Nr. 124. Die Verteilung des Niederschlags auf der festen Erdoberfläche. Von Alexander Supan. Gotha: Justus Perthes, 1898. Size 11 × 7½, pp. 104. *Maps.*

This will be specially noticed.

Mountain structure. *B.S. Languedoc. G.* **20** (1897): 165–183. **Rouville.**

Quelques mots de Géographie rationnelle. Par M. Paul de Rouville.

This paper, a continuation of that noticed in the *Journal* for January, p. 116, deals with the nature of mountain chains, and points out that these, to be studied logically, must be considered in the light of geological structure.

Oceanography. *G.Z.* **4** (1898): 203–210. **Maas.**

Die Aufgaben der Tiefseeforschung und die deutsche Tiefseeexpedition. Von Privatdozent Dr. phil. Otto Maas.

A rapid *résumé* of the results of modern oceanographical research.

ANTHROPOGEOGRAPHY AND HISTORICAL GEOGRAPHY.

Commercial Geography.

Commercial No. 1 (1898). Index to Reports of Her Majesty's Diplomatic and Consular Representatives Abroad on Trade and Subjects of General Interest. (With Appendix.) [In continuation of Commercial No. 8 (1896).] 1896 and 1897. London: Eyre & Spottiswoode, 1898. Size 10 × 6½, pp. 150. *Price* 7½*d.*

Commercial Geography. **Dubois and Kergomard.**

Précis de Géographie Économique. Par MM. Marcel Dubois et J. G. Kergomard. La France—l'Europe—l'Asie—l'Océanie—l'Afrique—les Amériques. Paris: Masson et Cie, 1897. Size 9 × 6, pp. viii. and 844. *Price* 10 *francs.*

This is a work of solid value. It is no mere compilation of recent statistics, but an admirably arranged and ably reasoned account of the economic geography of the world. It is right, also, to point out that no trace of political feeling tinges the descriptions of the countries outside France.

Commercial Geography. **Gulishambaroff.**

Stanislaus O. Gulishambaroff. The World's Commerce during the Nineteenth Century and Russia's share in it.—Zapiski, Imperial Russian Geographical Society, Statistical Section. VII. Part iii. [In Russian.] St. Petersburg, 1898. Size 10 × 6½, pp. xiv. and 230.

A statistical study of the international trade of the world during the latter half of the nineteenth century.

Commercial Geography—Gems. *J. Franklin I.* **145** (1898): 24–35, 133–143. **Kunz.**

Geography of Precious Stones. By George F. Kunz.

A study of the distribution of precious stones and the trade in them, concluding, "Since the dawn of history the principal markets for the gathering and distribution of precious stones have been probably the following: Ancient India, Egypt, Babylon, Tyre, Alexandria, Rome, Byzantium, Venice, Augsburg, Golconda, Goa, Colombo, Ratnapura, Amsterdam, Antwerp, Paris, and London. For the semi-precious stones and agates, Oberstein in Germany, St. Claude in the French Jura, and the great fair at Nijni Novgorod in Russia, are the most important; and the United States is the ultimate home of from one-third to one-half of the world's product."

BIOGRAPHY.

Bacler. *B.S. Topographie France* **21** (1897): 80–82. **Jung.**

Un général topographe. Notice Biographique (tirée de "la Plume et l'Épée" du 1er juin 1893). Par Bacler dit Bacler d'Albe, Louis Albert Guiselain (1761–1824). Par le Général Jung.

Gerando. *Rev. G.* **42** (1898): 1-4. **Reclus.**

Attila de Gerando. Par Élisée Reclus. *With Portrait.*

Mr. Gerando, born in 1847, died in 1897. He was the author of several memoirs on the geography of Hungary.

Ivens.

Roberto Ivens *With Portrait.* From *La Revue.* Illustrée du Portugal. 3ème Annee, Num. 2. Lisbonne: Février, 1898. Size 14 × 9½. *Presented by R. K. Gray, Esq.*

Rawlinson. **Rawlinson.**

A Memoir of Major-General Sir Henry Creswicke Rawlinson, Bart., K.C.B., F.R.S., etc. By George Rawlinson, M.A. With an Introduction by Field-Marshal Lord Roberts of Kandahar, V.C. London: Longmans & Co., 1898. Size 9 × 6, pp. xxii. and 358. *Map, Portraits, and Illustrations. Price* 16*s. Presented by the Publishers.*

This will be specially noticed.

Riehl. *Deutsche Rundschau G.* **20** (1898): 229-231. ——

Heinrich v. Riehl. *With Portrait.*

Herr von Riehl (born 1828, died 1897) was a journalist and historian who took part in several works of a largely geographical character.

Vespucci. *Riv. G. Italiana* **5** (1898): 86-88. **Masini.**

La data della nascita di Amerigo Vespucci. Nota di Enrico Masini.

Reasons for giving the date of birth of Vespucci as March 9, 1454.

Winsor. **Lane and Tillinghast.**

Justin Winsor, Librarian and Historian, 1831-1897. By William C. Lane and William H. Tillinghast. A Paper read before the Massachusetts Library Club, December 16, 1897. New York: Reprinted from the *Library Journal*, January, 1898. Size 10 × 8, pp. 10.

GENERAL.

Army Medical Report. ——

Army Medical Department. Report for the year 1896. With Appendix. Volume xxxviii. London: Eyre & Spottiswoode, 1897. Size 10 × 6½, pp. and 486. *Illustrations.*

Bibliography. **Cotgreave**

A Contents-Subject Index to General and Periodical Literature, to which is added an extensive list of works on subjects of general and special interest. Compiled by A. Cotgreave. Sections 7, 8, 9, 10. Campanella—Crystoleum. Size 8½ × 5½, pp. 97-160.

This contains a number of references to matters of geographical interest in general literature and popular magazines.

Bibliography. *B. New York Public Library* 2 (1898): 92-95. ——

Periodicals relating to Geography.

A list of the geographical publications, old and actual, in the Public Library of New York and the Library of Columbia University.

British Association Report. ——

Report of the Sixty-seventh Meeting of the British Association for the Advancement of Science held at Toronto in August, 1897. London: John Murray, 1898. Size 9 × 6, pp. cxvi., 908, and 112. *Presented by the Association.*

British Empire. *J.R. Statistical S.* **61** (1898): 1-48. **Baines.**

The Recent Course of Trade within the British Empire. By J. A. Baines, C.S.I.

A study of the trade relations of the British Empire during the last 30 years. The average value of exports and imports during the whole period and five-yearly means are given for each possession; and also tables of the variations of the trade of each, grouped according to commodities and according to foreign countries, and discussed in various other ways.

British Empire. *Le Globe, S.G. Genève* **37** (1898): 33-37, 43-53. **Chaix.**

L'Empire colonial de l'Angleterre en 1897. (Résumé.) Par M. le professeur Paul Chaix.

The veteran Prof. Paul Chaix, whose regard for this country is well known and cordially recognized, has, at the age of eighty, given this interesting contribution to the Diamond Jubilee celebration in the Geographical Society of Geneva.

NEW MAPS.

By J. COLES, *Map Curator*, R.G.S.

EUROPE.

England and Wales. **Bartholomew.**

New Reduced Ordnance Survey of England and Wales. Scale 1 : 126,720 or 2 stat. miles to an inch. Sheet 17, Shropshire. J. Bartholomew & Co., Edinburgh, 1898. *Price* 2*s.*, mounted on cloth. *Presented by the Publishers.*

England and Wales. **Ordnance Survey.**

Publications issued since April 8, 1898.

1-inch—General Maps:—

ENGLAND AND WALES:—280, 296, hills engraved in black and brown; and 26, 42, 43, 64, 72, 248, engraved in outline; 248, 273, 274, 346, hills engraved in black and brown (revision). **1s.** each.

6-inch—County Maps:—

ENGLAND AND WALES (revision):—**Essex,** 5 S.E., 8 N.E., 9 N.W., 14 N.E., 17 N.W., 23 N.W., 27 N.W., S.W., 28 S.E., 29 N.W., 33 N.W., 36 N.W., 38 N.W., 46 N.W., 47 N.E., 55 S.E., 57 N.E., 59 N.W., 61 N.E., S.W., 65 N.W., 66 S.E., 67 N.E., 68 N.W., 76 N.W., 77 S.E., 79 S.E., 87 N.W., N.E. **Hampshire,** 21 N.W., 44 N.W., N.E., S.W., 54 S.E., 62 S.E., 63 N.W., N.E., 64 N.W., S.W., S.E., 65 N.W. **Kent,** 2 S.E., 4 S.E., 32 S.E., 40 S.E., 42 S.W., S.E., 43 S.E., 52 N.E. **Middlesex,** 25 S.W. **Northumberland,** 59 N.W., 76 N.W., 79 S.W., 80 N.W., 83 S.E., 88 S.W., 91 N.E., 92 S.E., 93 N.W., 94 N.W., 95 N.E., 102 S.W., 103 N.E. **Surrey,** 14 N.E., 26 S.W., 45 N.E. **1s.** each.

25-inch—Parish Maps:—

ENGLAND AND WALES (revision):—**Cheshire,** III. 12; IV. 7, 9, 11, 13; IX. 10, 14, 15; XI. 10; XVIII. 3, 4, 10, 11, 12, 15; XIX. 4, 6, 10; XXVI. 2, 3, 4, 6, 8; XXVII. 2, 3, 4, 7, 8, 10, 12; XXVIII. 1, 9, 13; XXXV. 7, 10, 11; XXXVI. 8, 12; XLII. 6, 8, 10, 14; XLIX. 6, 7, 8, 10, 14, 16; L. 5, 7, 9, 10, 13, 14, 16; LI. 2, 13; LVII. 2, 6; LXII. 1, 5. **Derbyshire,** IV. 9, 10; V. 4, 8, 12; VI. 9, 13; VII. 1, 2, 5, 6; IX. 1, 2, 4, 7. **Durham,** II. 13; X. 9; XI. 2; LV. 5, 6, 10; LVI. 11; LVII. 12. **Essex,** XVII. 9; XXI. 15. **Hampshire,** LXXV. 5, 16; LXXVI. 12; LXXIX. 15, 16; LXXXIV. 1, 5, 6; LXXXVII. 3, 11, 12; XCIII. 3, 11, 13; XCIV. 11, 12, 16; XCV. 5, 10, 12, 13; XCVII. 2, 3. **Hertfordshire,** III. 4, 7, 15; IV. 1, 5, 9; VII. 11, 15; VIII. 2, 3; XI. 8, 15; XII. 3, 5, 6, 13, 15, 16; XIV. 13; XX. 3, 4, 5, 14, 15, 16; XXI. 4, 5, 14, 16; XXII. 14, 15; XXIII. 10; XXVIII. 1, 3, 8, 12, 13, 16; XXIX. 1, 2, 3, 4, 5, 7, 9; XXX. 1, 2, 3, 10; XXXI. 5; XXXIV. 6, 10, 12, 16; XXXV. 1, 2, 4, 5, 13; XXXVI. 5, 12, 15; XXXIX. 4, 6, 15; XL. 3, 4; XLI. 3, 5, 7, 10; XLIV. 3, 4, 12, 15; XLV. 5, 6, 11. **Kent,** V. 16; XXIII. 12; XXIV. 5, 6, 7, 8, 9, 10, 11, 12, 16; XLVI. 2, 6, 9, 10, 11, 12, 13, 15; XLVII. 2, 4, 12; LVII. 13, 14; LIX. 5; LXVII. 9, 10, 11, 13, 14; LXXII. 2, 6, 8; LXXXIV. 7, 9, 11, 15. **Northumberland,** XI. 4; LXXXVIII. 15, 16; XCVII. 3; CII. 14. **Surrey,** XLVII. 5. **Sussex,** I. 16; II. 13; III. 3, 4; IV. 1, 2, 8; X. 6; XII. 4, 5; XX. 3, 7, 11; XXXIII. 12; XLVII 6; LII. 14, 15, 16; LIII. 13, 14, 15, 16; LXI. 11, 14, 16; LXII. 13; LXIII. 13; LXIV. 8, 9, 10, 11, 12, 13; LXV. 1, 2, 3, 4, 6; LXVI. 1, 2, 3, 4, 7, 8, 11, 12, 15; LXXII. 8, 12; LXXIII. 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 14, 15 and 16; LXXIV. 2, 7; LXXVI. 1; LXXVII. 3 and 4; LXXXI. 1 and 6, 2, 3, 7. **Westmorland,** XXXVIII. 14, 16; XXXIX. 1, 6, 7, 9, 10, 11, 13, 14, 15; XL. 13; XLII. 1, 2, 3, 4, 9, 11, 13, 14; XLIII. 1, 2, 3, 4, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16; XLIV. 1, 5, 9, 13; XLVI. 1, 2, 3, 4, 6, 7, 8, 9; XLVII. 1, 2, 3, 5, 8, 10, 11, 12, 13; XLVIII. 1, 5. **2*s.* 6*d.*** each.

(*E. Stanford, Agent.*)

Historical Atlas. **Poole.**

Historical Atlas of Modern Europe, from the Decline of the Roman Empire; comprising also maps of parts of Asia and of the New World, connected with European History. Edited by Reginald Lane Poole, M.A., PH.D., Fellow of Magdalen College, and Lecturer in Diplomatic in the University of Oxford. Part xvii. Oxford: The Clarendon Press; London, Edinburgh, Glasgow, and New York: Henry Frowde, M.A.; Edinburgh: W. & A. K. Johnston, 1898. *Price* 3*s.* 6*d.* *Presented by the Clarendon Press.*

Part No. xvii. of this atlas contains the following maps: No. 22, England and Wales after the Accession of the House of Tudor, by the editor; No. 69, Italia Sacra,

illustrating the Ecclesiastical Divisions in the Middle Ages, by Miss K. Dorothea Ewart; No. 89, European Colonies and Dependencies, and States independent of European Powers, 1815–1897, by Hugh E. Egerton, M.A. Each of these maps is accompanied by letterpress.

AFRICA.

German East Africa. **Werther.**

Originalkarte der Irangi-Expedition in den mittleren Hochländern des nördlichen Deutsch-Ost-Afrika, Juli 1896 bis April 1897. Nach den astronomischen Ortsbestimmungen, Aufnahmen und eigenhändigen Konstruktionen des Führers der Expedition. Premierlieutenant W. Werther. Scale 1 : 750,000 or 10·3 stat. miles to an inch. *Petermanns Geographische Mitteilungen.* Jahrgang 1898, Tafel 6. Gotha: Justus Perthes. *Presented by the Publisher.*

Limpopo River. **Commissão de Cartographia, Lisbon.**

Reconhecimento hydrographico do Rio Limpopo, desde a sua fóz até á confluencia do Chengane. Scale 1 : 39,816 or 0·63 stat. mile to an inch. 1897.—Reconhecimento da Barra do Limpopo. Scale 1 : 10,000 or 0·15 stat. mile to an inch. 1897.—Levantado em 1896 por Valente da Cruz, 2° tenente da armada. Ministerio da Marinha e Ultramar, Commissão de Cartographia. Lisbon. *Presented by the Commissão de Cartographia, Lisbon.*

This map contains a survey of the Limpopo river from the confluence of the Chengane to its mouth. Soundings are given as far up the river as Languene, and a plan on an enlarged scale is given of the entrance. On the map there are some useful notes with reference to the navigation.

Nile. **Philip.**

New Map of the Nile from its Mouth to Khartum, illustrating the operations of the Egyptian Army in the Sudan. Scale 1 : 2,555,000 or 40·8 stat. miles to an inch. London: G. Philip & Son. 1898. *Price* 1*s.* *Presented by the Publishers.*

South-East Africa. **Commissão de Cartographia, Lisbon.**

Africa Oriental Portugueza. Scale 1 : 1,000,000 or 15·8 stat miles to an inch. Sheets: No. 4, Zumbo—Tete; No. 8, Quelimane—S. fala. Published by the Ministerio da Marinha e Ultramar, Commissão de Cartographia. Lisbon, 1896–97. *Presented by the Commissão de Cartographia, Lisbon.*

These are two sheets of a map of Portuguese East Africa in course of publication. With the exception of that part of the river between Sena and Sango, the whole course of the Zambesi is shown from the delta to Zumbo, with the surrounding country.

West Africa. **Commissão de Cartographia, Lisbon.**

(1) Reconhecimento do Rio Cacheu. Provincia da Guiné, 1897. (2) Reconhecimento do Canal do Impernal e Rio Mansoa. Provincia da Guiné, 1897. (3) Plan do Porto e Cidade de Dilly. 2nd Edição, 1895. (4) Esboço Rapido da Communicação entre o Rio Tombali eo Cacine, Provincia da Guiné, 1897. (5) Reconhecimento do Rio Geba, 1897. (6) Reconhecimento do Rio Mansôa, 1897. Provincia da Guiné. (7) Esboço do Rio Corubal, entre o Rio Geba e porto Ugui. Provincia da Guiné, 1897. (8) Reconhecimento hydrographico da Barra e Porto de Angoche, 1897. Provincia de Moçambique. Ministerio da Marinha e Ultramar, Commissão de Cartographia. *Presented by the Commissão de Cartographia, Lisbon.*

AMERICA.

Klondike. **Philip.**

Philip's Sketch-Map of the Klondike Gold Region, Yukon District, Dominion of Canada. Compiled from the latest authentic sources, and from information supplied by the Klondike Parent Pioneer Corporation, Ltd. Approximate scale 1 : 126,720 or 2 stat. miles to an inch. G. Philip & Son, London & Liverpool, 1898. *Price* £1 1*s.* *Presented by the Publishers.*

The principal map on this sheet is drawn on a scale of 2 miles to 1 inch, and contains all that is known of this territory. The auriferous creeks are printed in gold, other creeks and rivers in blue, and the hill shading in brown. Notes are given on river navigation, value of gold taken from various localities, particulars about discovery and Government claims, tables of distances and through rates from Liverpool, and other items of useful information. An inset on a large scale is given, showing all the claims on the Bonanza, Eldorado, and tributary creeks; this has been compiled from drawings in the office of the gold commissioner, Dawson.

North America. **Stanford.**

Stanford's Map of the United States (Eastern Part) and Cuba. Scale 1 : 5,385,600 or 85 stat. miles to an inch. E. Stanford : London, 1898.

United States and Spain. **Johnston.**

War Map with United States and Spain. 2nd edit. W. & A. K. Johnston, Edinburgh and London, 1898. *Price* 1*s*. *Presented by the Publishers.*

This sheet contains seven maps, on various scales, the principal being one of the West India islands, and another of the south-eastern part of the United States.

Yukon Gold Fields. **Canadian Pacific Railway Co.**

Map of the Canadian Pacific Railway and Connections, showing Routes to the Yukon Gold Fields, Alaska, Klondike, and the North-Western Mining Territories of Canada. Scale 1 : 6,570,000 or 105 stat. miles to an inch. *Presented by the Canadian Pacific Railway Co.*

GENERAL.

The World. **Andree.**

Andrees allgemeiner Handatlas, 126 Haupt- und 130 Nebenkarten auf 186 Kartenseiten, nebst alphabetischen Namenverzeichnis. Vierte, völlig neubearbeitete, stark vermehrte Auflage, herausgegeben von A. Scobel. Bielefeld und Leipzig : Verlag von Velhagen and Klasing, 1898.—Lief II. Nieder -und Ober-Österreich, Steiermark, Kärnten, Krain und Küstenland : Griechenland.—Lief III. Vegetationsgebiete, Meeresströmungen und Kulturpflanzen : Schleswig-Holstein, Mecklenburg und Freie Städte Hamburg und Lübeck.—Lief IV. Übersichtskarte von Schweden und Norwegen : Südamerika, Nördliche Hälfte.—Lief V. Königreich Sachsen : Westrussland, Nördlicher Teil.—Lief VI. Provinz Sachsen und Herzogtum Anhalt : Mittelitalien.—Lief VII. Hannover, Oldenburg, Braunschweig und Freie Stadt Bremen : Hinterindien und Malayischer Archipel.—Lief VIII. Provinzen West- und Ostpreussen : Böhmen, Mähren und Österreichischen-Schlesien.—Lief IX. Nordostfrankreich : Südöstliche Vereinigte Staaten, Cuba und Bahamainseln.—Lief X. Niederlande und Belgien : England und Wales, Südliche Hälfte.—Lief XI.—Übersichtskarte von Italien : Nord-Asien. *Price* 50 *pf. each part.*

This atlas is now being issued at the rate of one part each week, and eleven have already appeared.

PHOTOGRAPHS.

Mexico. **Krauss.**

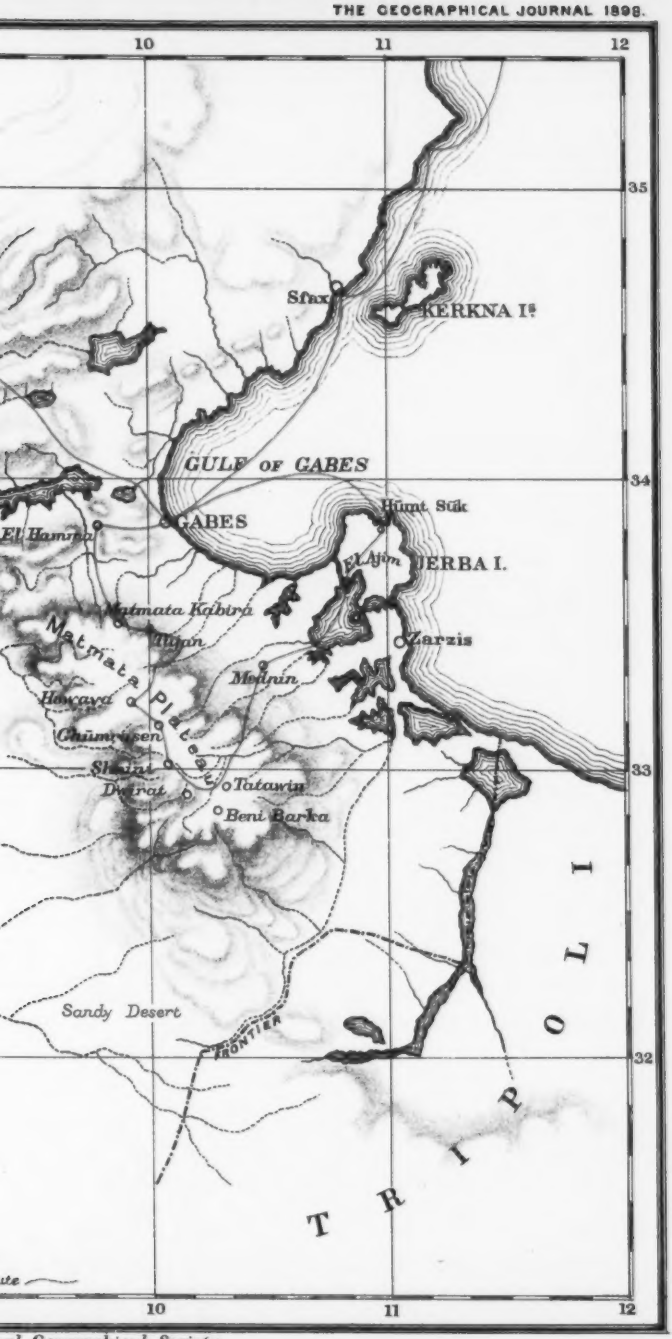
Twenty-two Photographs of Mexico, taken by A. Krauss, Esq., during the expedition of J. Gurdon L. Stephenson, Esq., 1897. *Presented by J. Gurdon L. Stephenson, Esq.*

Though these photographs are of small size, they are very clear, suited for making lantern slides, and would, no doubt, bear enlargement. As will be seen by the following list of titles, they form an interesting series.

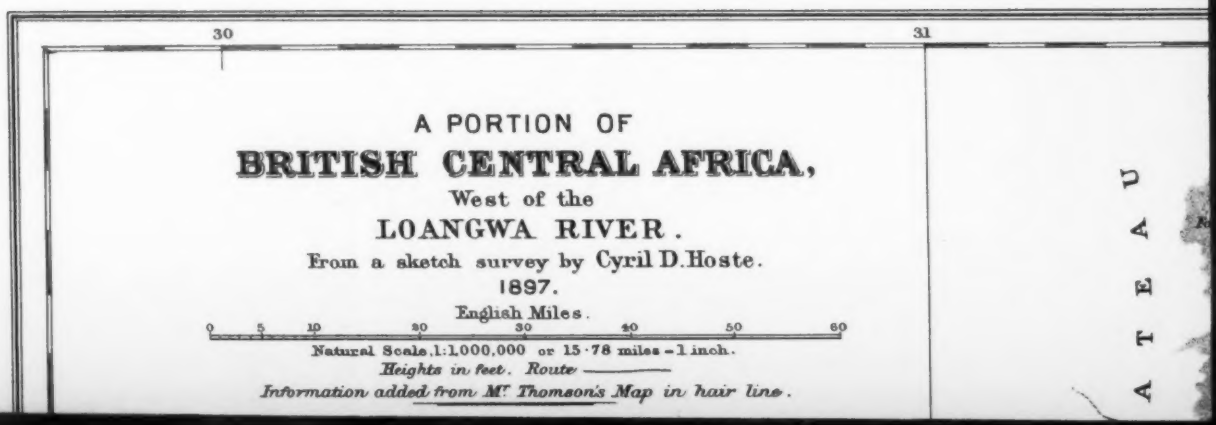
(1) Tarahumari Indians working in the Arroyo Eglesia ; (2) House, Realito ; (3) Fording Fuerte river, near Fuerte, dry season ; (4) Ox-waggon, Carichic ; (5) Batopilas Conducta coach and waggon at Ojos, Anjule's ranch : (6) House at Tehueco ; (7) Tasajera ; (8) Corral, Colorado ranch ; (9) On trail near Realito ; (10) On trail near Rodes ; (11) Indian blanket loom at Charay ; (12) Tarahumari Indians and store-house at Pilares ; (13) Fording Fuerte river near San Ignacio : (14) Passing pack-train on trail between Batopilas and Calabases ; (15) Fording Urique river near Siquirichic ; (17) Ass dragging log, Fuerte ; (17) Realito on Batopilas river ; (18) Mules towing dug-out across Fuerte river, rainy season ; (19) Rock in the Sivirijoa Arroyo, showing old carvings ; (20) Fording Urique river near Siquirichic, Batopilas Conducta ; (21) Crossing Fuerte river near Fuerte, rainy season—horse towing ; (22) Batopilas Conducta coach at Carichic.

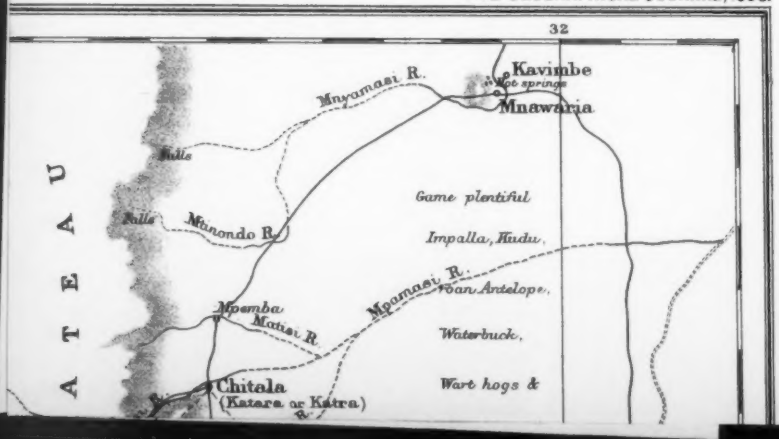
N.B.—It would greatly add to the value of the collection of Photographs which has been established in the Map Room, if all the Fellows of the Society who have taken photographs during their travels, would forward copies of them to the Map Curator, by whom they will be acknowledged. Should the donor have purchased the photographs, it will be useful for reference if the name of the photographer and his address are given.

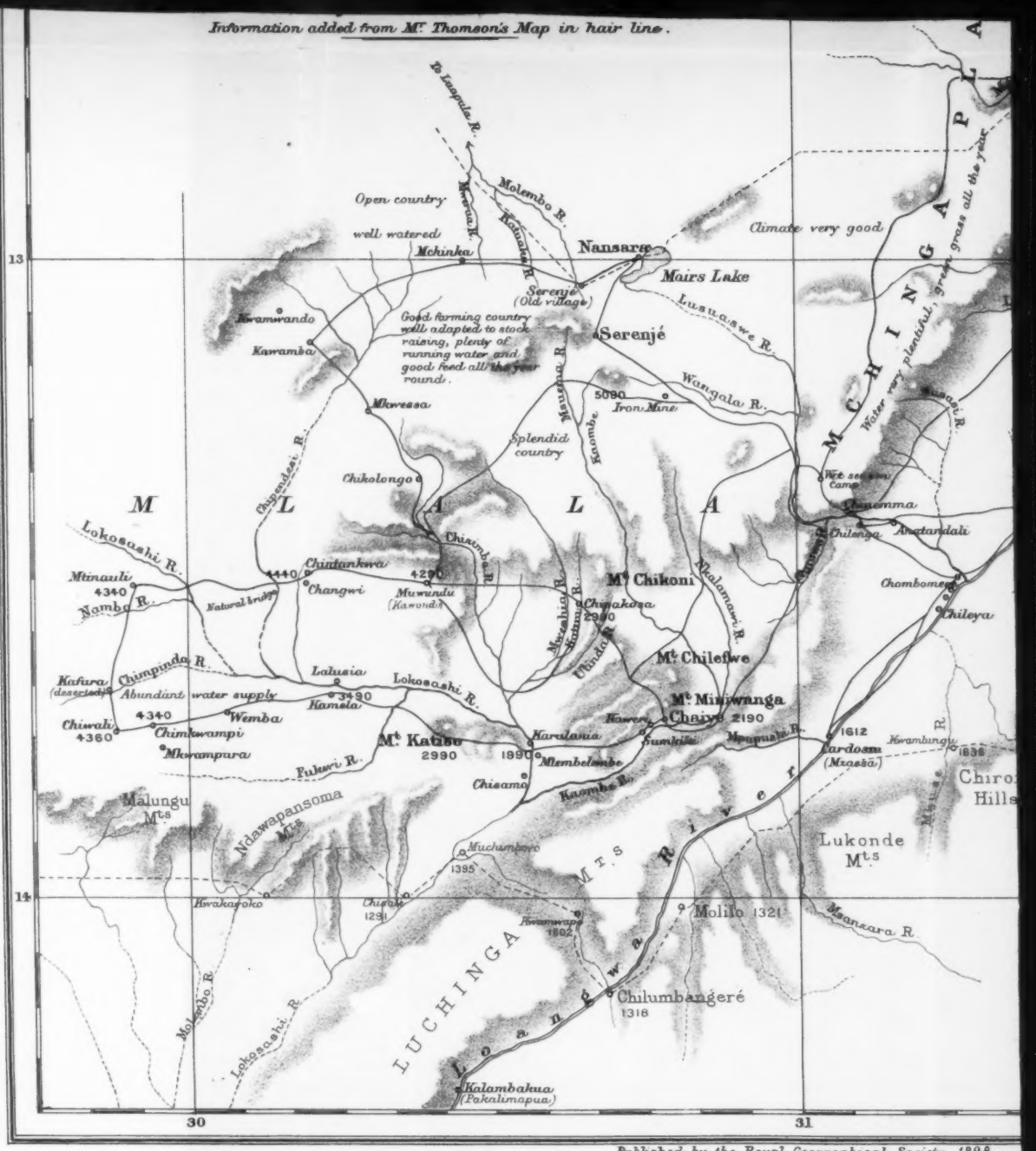
Published by the Royal G



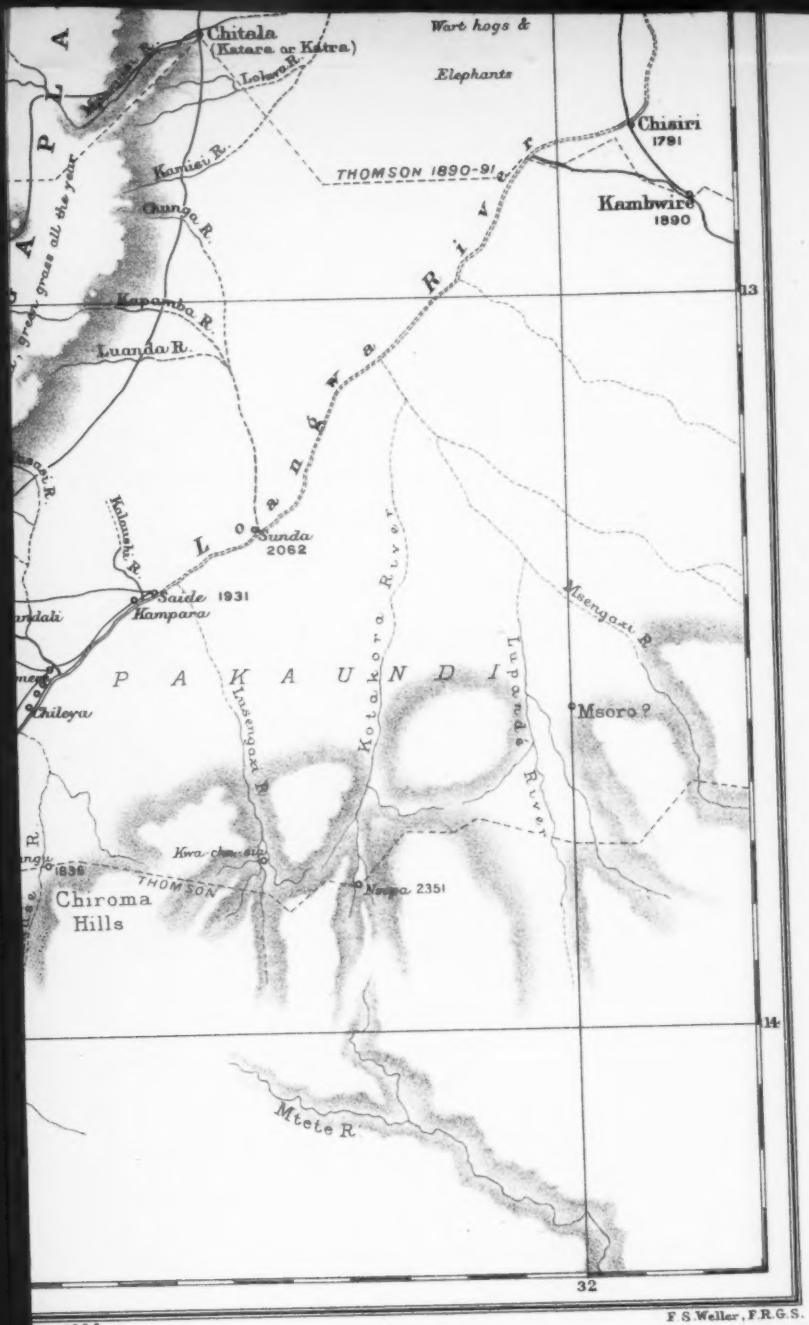
al Geographical Society.


30
31
A PORTION OF
BRITISH CENTRAL AFRICA,
West of the
LOANGWA RIVER.
From a sketch survey by Cyril D. Hoste.
1897.
English Miles.
0 5 10 20 30 40 50 60
Natural Scale 1:1,000,000 or 15·78 miles = 1 inch.
Heights in feet. Route
Information added from Mr Thomson's Map in hair line.
A T E A U

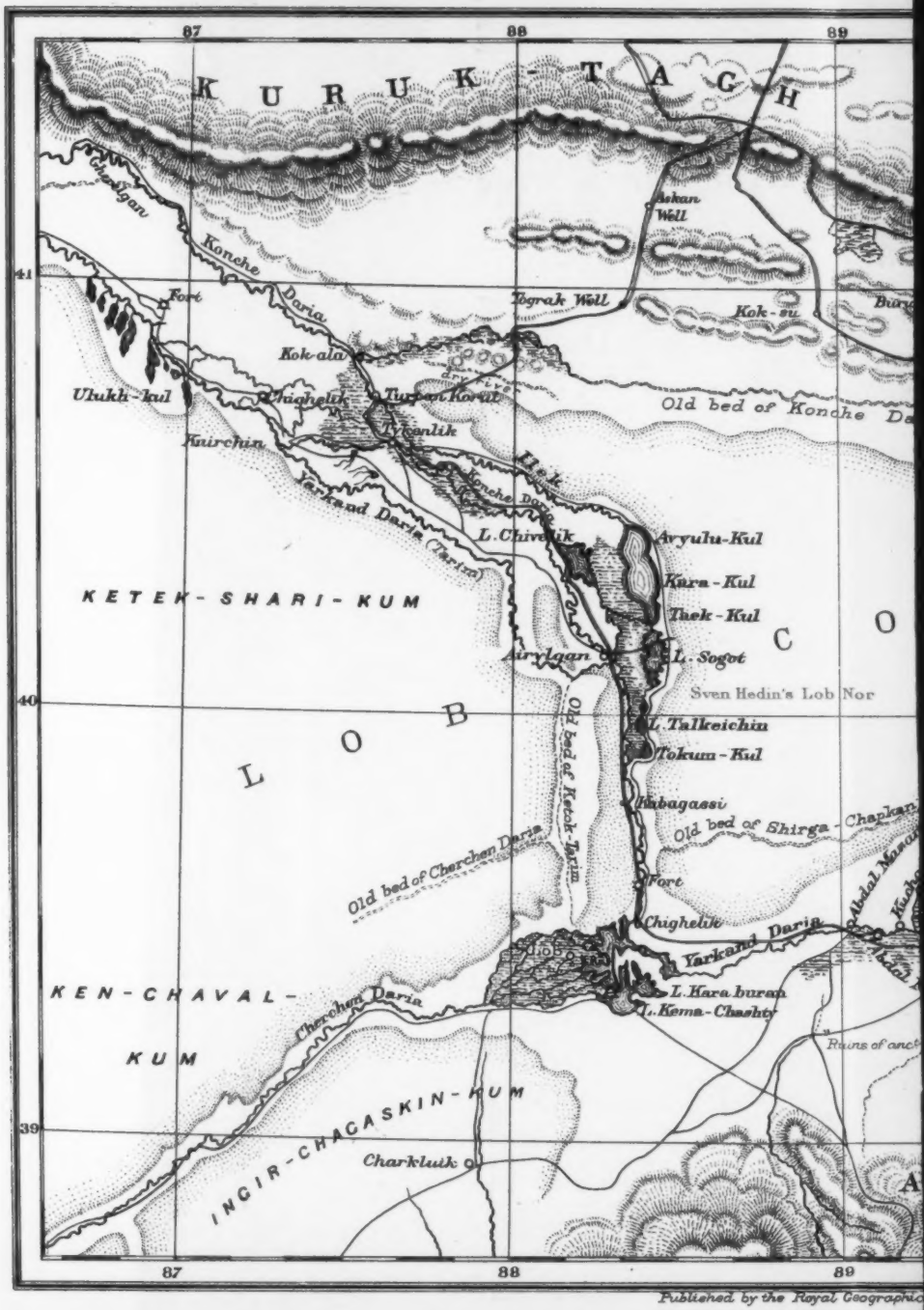

32
Kavimbe
Hot springs
Mnawaria
Mnyamasi R.
Hills
Hills
Manondo R.
Game plentiful
Impalla, Kudu,
Roan Antelope,
Waterbuck,
Wart hogs &
Mpamasi R.
Mpemba
Matisi R.
Chitala
(Katara or Katra)
ATEAU

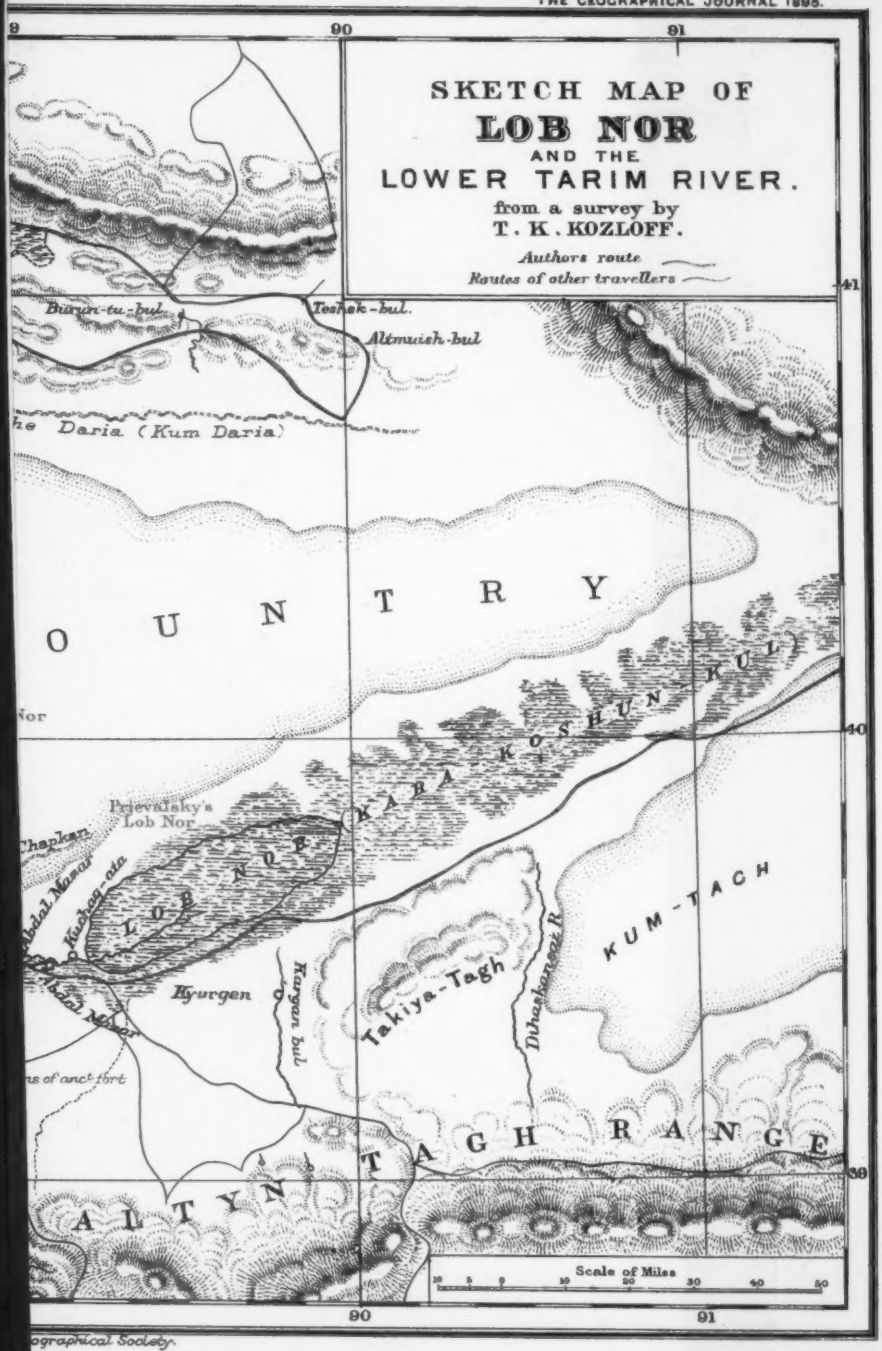


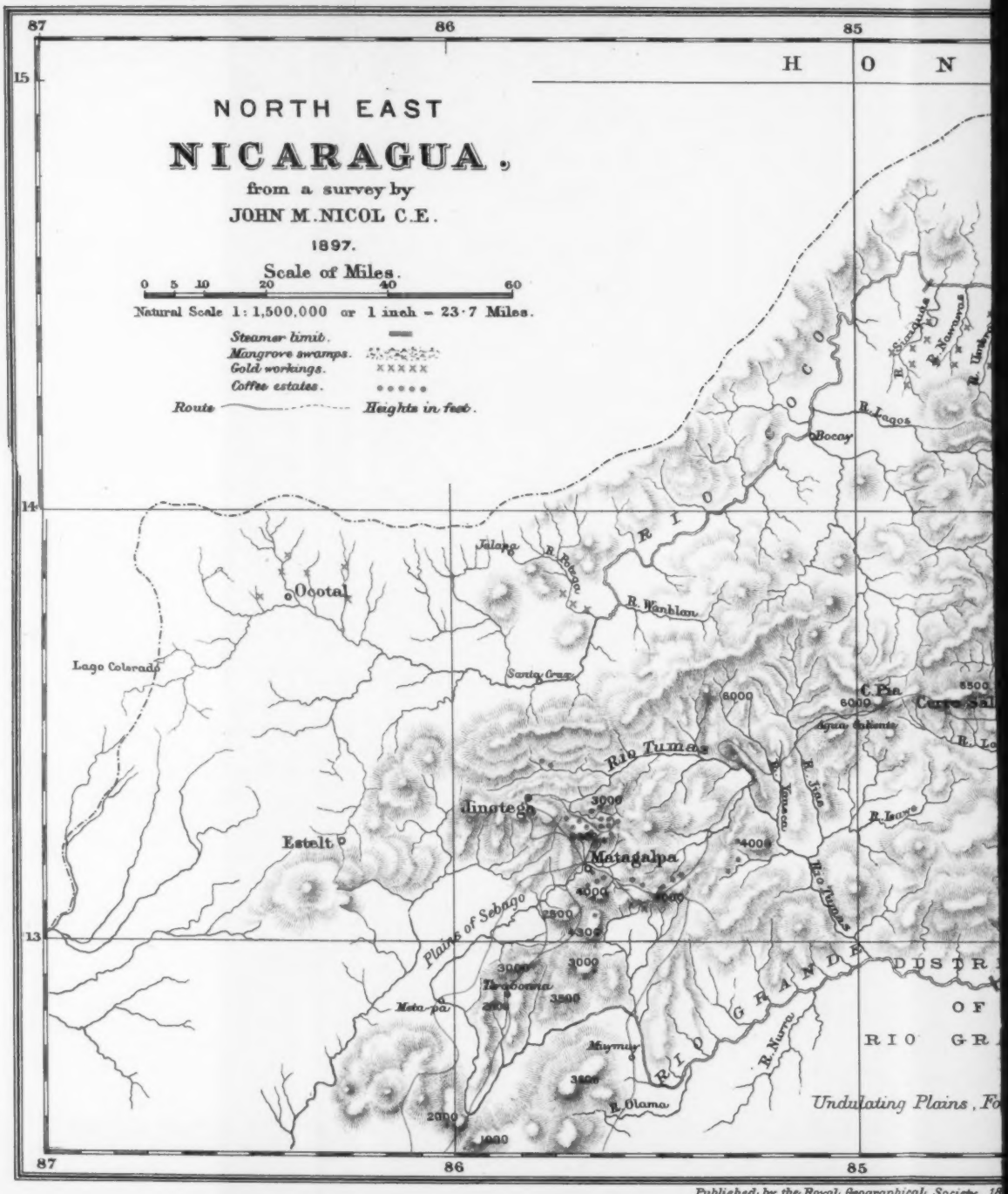
Published by the Royal Geographical Society, 1898.

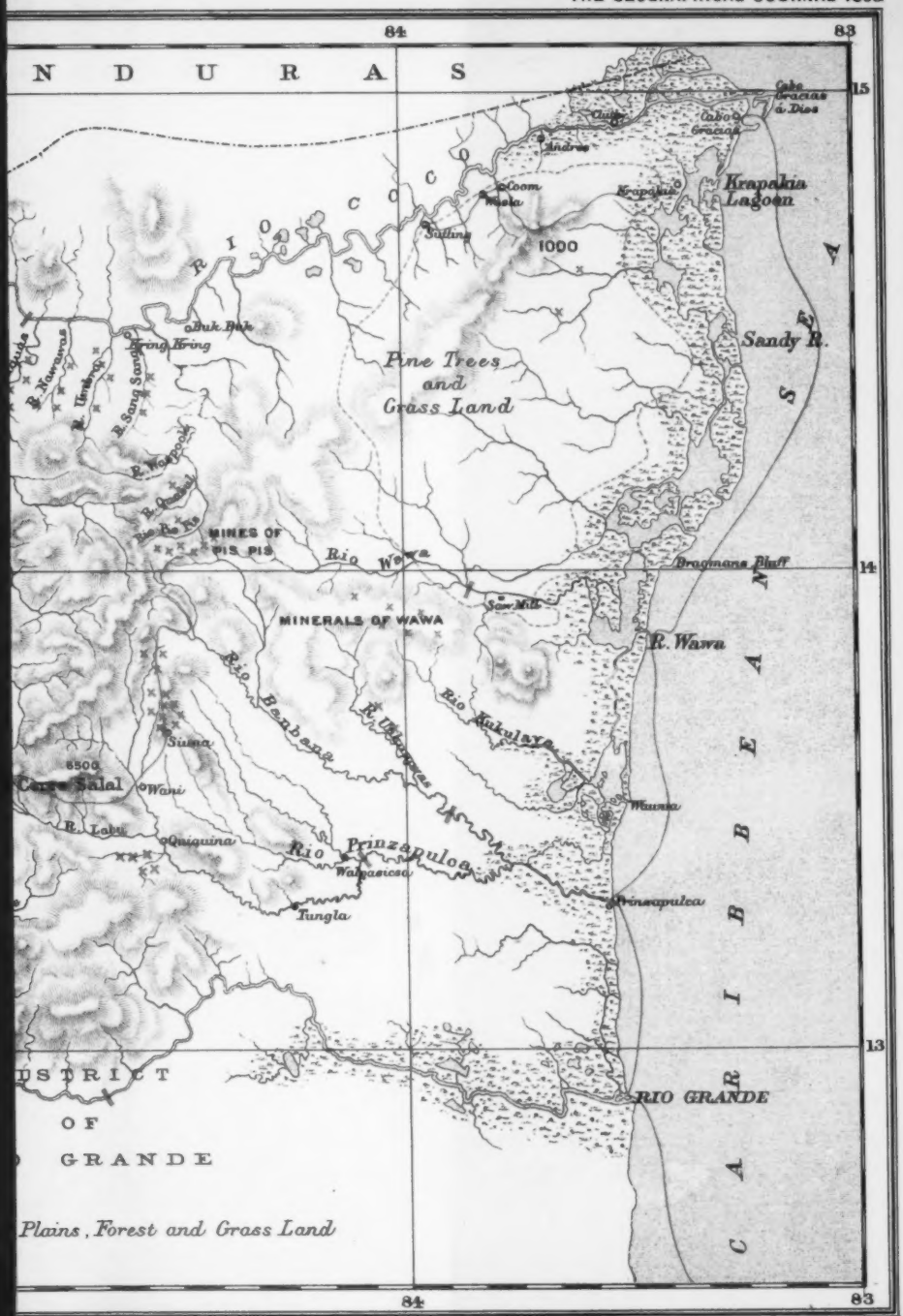


F S Weller, F R G S.


87
88
89
KURUK-TAGH
Askan Well
Konche Daria
Fort
Tograk Well
Kok-ala
Ulukh-kul
Chighelik
Tumat Korak
Tyrenlik
Old bed of Konche Da
Kuirchin
Yarkand Daria (Tarim)
L. Chiveklik
Avyulu-Kul
Kara-Kul
Thek-Kul
KETEK-SHARI-KUM
Airylgan
L. Sogot
Sven Hedin's Lob Nor
LOB
L. Talkeichin
Tokum-Kul
Ihbagassi
Old bed of Ketek-Tarim
Old bed of Shirga-Chapkan
Old bed of Cherchen Daria
Fort
Chighelik
Yarkand Daria
KEN-CHAVAL-KUM
Cherchen Daria
L. Kara buran
L. Kema-Chashty
Ruins of anc
INGIR-CHAGASKIN-KUM
Charkluk
41
40
39
87
88
89
Published by the Royal Geographic


SKETCH MAP OF
LOB NOR
AND THE
LOWER TARIM RIVER.
from a survey by
T. K. KOZLOFF.
Authors route
Routes of other travellers
89
90
91
41
40
39
Burun-tu-bul.
Teshek-bul.
Altmuish-bul
he Daria (Kum Daria)
O U N T R Y
Nor
K U L
K A B A K O S H U N
Prjevalsky's
Lob Nor
Chapkan
L O B N O R
Kyurgen
Kargan bul
Takiya-Tagh
Dzharkamaz R.
KUM-TACH
ns of ancient fort
A L T Y N T A G H R A N G E
Scale of Miles
10 5 0 10 20 30 40 50
ographical Society.


NORTH EAST
NICARAGUA.
from a survey by
JOHN M. NICOL C.E.
1897.
Scale of Miles.
0 5 10 20 40 60
Natural Scale 1:1,500,000 or 1 inch = 23·7 Miles.
Steamer limit.
Mangrove swamps.
Gold workings.
Coffee estates.
Route
Heights in feet.
H O N
87
86
85
15
14
13
Ocotal
Lago Colorado
Jalapa
R. Tepaca
R. Wanblan
Santa Cruz
Rio Tuma
Jinotega
Estelí
Matagalpa
Plains of Sebago
Metapa
Muymuy
R. Olama
R. Jicaro
R. Tuma
R. Nurra
R. Lagos
Bocay
C. Pin
Agua Caliente
Undulating Plains, Fo
RIO GR
DISTR
OF
Published by the Royal Geographical Society, 18



al Society, 1898.

F. S. Waller, F.R.G.S.

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